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## یادداشت :

Compared with the industrial and service sectors, agriculture remained the most sluggish sector of the economy. In 1988 the contribution of agriculture to overall GDP was only about 10.8 percent, down from approximately 12.3 percent the previous year. Most economists agreed that the country's rural areas had gained more than they had contributed in the course of industrialization. Still, the growth of agricultural output, which averaged 3.4 percent per year between 1945 and 1974, 6.8 percent annually during the 1974-79 period, and 5.6 percent between 1980 and 1986, was credible. The gains were even more impressive because they added to a traditionally high level of productivity. On the other hand, the overall growth of the agriculture, forestry, and fishing sector was only 0.6 percent in 1987 as compared with the manufacturing sector, which grew 16 percent during 1986 and 1987. During the first half of 1989, the agriculture, forestry, and fisheries sector grew 5.9 percent, as opposed to manufacturing's 2.9 percent.

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## Heat Stress and Livestock Industry in South Korea

### 1. Heat Stress and Water restriction; Hair Cortisol Levels

Heat stress causes major losses (\$ 2.4 billion) in animal production, including dairy cattle, beef cattle, swine and poultry in the USA (St-Pierre *et al.* 2003). Heat stress affects feed intake, body temperature, maintenance requirements and metabolic processes, feed efficiency, milk yield, reproductive efficiency, behavior and disease incidence (Cook *et al.* 2007; Tucker *et al.* 2007; Rhoads *et al.* 2009). Water is necessary for a proper rumination and digestion (Casamassima *et al.* 2008). In addition, water loss from the body occurs via urine, feces and milk; through sweating and by evaporation from body surfaces and the respiratory tract (West 2003). However, the amount of water loss from a cow's body is influenced by activity, air temperature, humidity, respiratory rate, water intake, feed consumption, milk yield and other factors. Water restriction could intensify the effect of heat stress related to performance including digesta flow rate, saliva excretion and nutrient digestibility or blood parameters and decreased performance of animals (Mariat *et al.* 2007). Furthermore, water is consumed several times per day and generally is associated with feeding or milking. Cows may consume about 50 percent of their daily water intake within 1 h following milking (Beede 1992; NRC 2001). Peak of water intake for cows occurs during the hours when feed intake is greatest (Beede 1992). When given the opportunity, cows tend to alternately consume feed and drink water (Nocek and Braund 1985). High yielding dairy cows are more sensitive to water restriction than sheep or other small ruminants (Mariat *et al.* 2007; Casamassima *et al.* 2008).

If there are high amounts of degradable nitrogen or if the content and rate of carbohydrates degradation in the rumen is reduced or not synchronized with the degradation of protein, there could be losses of nitrogen and/or energy in the rumen. Water restriction may alter the synchronization between carbohydrate and protein in the rumen. Earlier studies have investigated water restriction as a percent of *ad libitum* intake in small ruminants (Ahmed Muna and Shafei Ammar 2001; Casamassima *et al.* 2008; Alamer 2009) and cows (Burgos *et al.* 2001; Seifet *et al.* 1972; Balch *et al.* 1953), but water restriction immediately following feeding, has not been studied in lactating cows, especially under heat stress conditions.

Cortisol is a biomarker of the physiological response to stress, including heat stress. This hormone is usually measured in blood serum or plasma, requiring stressful handling procedures such as capturing, restraining animals, and venipuncture or blood collection from catheter. These procedures can potentially confound the reliability of the assessment (Creel *et al.*, 1992; Davenport *et al.*, 2006) and provide highly variable data in blood. Coping with this issue, stressful sample collection can be avoided by using alternative sample matrices such as urine, feces, or saliva (Accorsi *et al.*, 2008). Each has clear limitations as explained by Davenport *et al.* (2006). Samples derived from restrained animals are problematic because stress may alter blood and urine hormonal levels (Creel *et al.*, 1992). One technique to minimize these limitations is to measure cortisol in the matrix of hair, suggested by Yamada *et al.* (2007). Cortisol concentrations in the biological matrices may be affected by stress-induced changes in the hypothalamus-pituitary axis over extended periods of time (Comin *et al.*, 2011).

As cortisol in the hair is not affected by short-term environmental factors such as handling, it may be a reliable approach to measure endogenous cortisol.

### 2. Livestock Industry in Korea

At the start of the economic boom in 1963, the majority of South Koreans were farmers. Sixty-three percent of the population lived in rural areas. In the next twenty-five years, South Korea grew from a predominantly rural, agricultural nation into an urban, newly industrialized country and the agricultural workforce shrunk to only 21 percent in 1989. Government officials expected that urbanization and industrialization would further reduce the number of agricultural workers to well under 20 percent by 2000.

South Korea's agriculture had many inherent problems. South Korea is a mountainous country with only 22 percent arable land and less rainfall than most other neighboring rice-growing countries. A major land reform in the late 1940s and early 1950s spread ownership of land to the rural peasantry. Individual holdings, however, were too small (averaging one hectare, which made cultivation inefficient and discouraged mechanization) or too spread out to provide families with much chance to produce a significant quantity of food. The enormous growth of urban areas led to a rapid decrease of available farmland, while at the same time population increases and bigger incomes meant that the demand for food greatly outstripped supply. The result of these developments was that by the late 1980s roughly half of South Korea's needs, mainly wheat and animal feed corn, was imported.