EXECUTIVE SUMMARY
While the expected benefits and challenges of RFID technology have been well studied in the manufacturing and service sectors at the private organization level, there is little understanding of these two issues when exploring RFID adoption in the agricultural field and at the public organizational level. Previous tracking programs in Kuwait have been unsuccessful in reducing illegal activities that lead to fraud and the wasting of public money in animal feed programs. To alleviate these problems, an RFID program, supported by information systems, was designed to help monitor and control feed distribution and animal tracking. Unlike previous studies, this case study describes the application of RFID for the tracking and monitoring of livestock by the Kuwait Public Authority of Agriculture Affairs and Fish Resources in Kuwait. It reviewed the subsidy process before and after RFID adoption and found a large reduction in the actual number of animals claimed after RFID adoption which reduced fraud and increased animal accountability.

Keywords: RFID application, RFID investment, RFID advantages, RFID obstacles, Top management support, RFID cost, information system, electronic commerce

ORGANIZATION BACKGROUND
Even through RFID technology seems to have emerged quite recently, the concept is not new. It has its origins in military applications during World War II, when the British Air Force used RFID technology to distinguish allied aircraft from enemy aircraft with radar (Asif and Mandviwalla, 2005). RFID received great attention by academia and practitioners after the Society of Information Management (SIM) conducted its last survey of Information Technology executives, and RFID was rated among the top 20 developments in application and technology (Luftman et al., 2006). Literature review papers on RFIDs (e.g. Roussos and Kostakos 2009) identified a variety of RFID applications including supply chain, ticketing, asset tracking, retail stores, personal identification, library books, hospitals, and animal tracking. Moreover, these studies have shown numerous potential advantages as listed in table 1.

<table>
<thead>
<tr>
<th>Enumerated benefits</th>
<th>References</th>
<th>Categorized benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve quality</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Automate manpower</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Reduce errors</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Reduce inconsistencies in stock</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Optimize stock keeping</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Improve customer service</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
</tbody>
</table>

Improve process management
<table>
<thead>
<tr>
<th>Benefit</th>
<th>Reference</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce manpower</td>
<td>Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Reduce counterfeits</td>
<td>Kinsella (2003); Leimeister et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Reduce labor cost</td>
<td>Kinsella (2003)</td>
<td></td>
</tr>
<tr>
<td>“Bullwhip effects” reduction</td>
<td>Higgins and Cairney (2006); Roh et al., (2009)</td>
<td>Supply Chain visibility</td>
</tr>
<tr>
<td>Uncertainty of product availability reduction</td>
<td>Asif and Mandviwalla (2005); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Reduction in out-of-stock, delivery and safety stock</td>
<td>Kinsella (2003); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Inventory obsolescence material handling cost reduction</td>
<td>McFarlane and Sheffi (2003); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Rich information change among suppliers</td>
<td>Asif and Mandviwalla (2005); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Inventory monitoring</td>
<td>McFarlane and Sheffi (2003); Higgins and Cairney (2006); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Efficiency measurement</td>
<td>Higgins and Cairney (2006); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>New process creation</td>
<td>Sheffi (2004); Asif and Mandviwalla (2005); Hoffman (2006); Roh et al., (2009)</td>
<td>New process &amp; product creation</td>
</tr>
<tr>
<td>Communication of the components parts to a reader</td>
<td>Higgins and Cairney (2006); Roh et al., (2009)</td>
<td></td>
</tr>
<tr>
<td>Quality control</td>
<td>Hoffman (2006); Roh et al., (2009)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1:** Summary of expected benefits from RFID adoption from past studies

Firms are making huge investments in information technology to improve their efficiency. Available statistics, according to IDTechEx, a market research, specializing in RFID (www.idtechex.com), estimates that more than 3.7 billion RFID tags have been deployed in the field by 2007 (with more than 1.6 billion new tags introduced in 2006 alone) and this trend is accelerating. Another consulting firm, eMarketer, 2005, estimates that worldwide investments in RFID technology may rise from $363 million in 2004 to almost $3000 billion in 2010. However, the impacts from these investments remain a challenging and controversial task to assess. For example, Brynjolfsson and Hitt (1996) concluded that IT investments can lead to cost savings, improved quality in service and better customer service. However, Willcocks and Lester (1994) suggested that there is no clear link between IT spending and a
firm's gains in terms of market share or profitability, while others have concluded that the value of IT is high when the adoption is aligned with the organization's strategic objectives (Chan and Reich 2007). A recent study found the existence of a high correlation between perceived potentials of RFID and CIO's intention to invest in RFID (Leimeister et al., 2009); however, the real challenge facing decision makers, as is the case of the PAAF, is how to systematically leverage the potential of RFID in other cultures and settings (Curtin et al., 2007; Leimeister et al., 2009) and how to align the application with the organizational objectives.

While there is a growing interest in the application of RFID and several conceptual and empirical studies do exist (Ngai et al., 2008; Roh et al., 2009; Leimeister et al., 2009), there is, however, a dearth of case studies or research that report the benefits and challenges of using RFIDs. The following are exceptions: RFID case studies in the healthcare industry (Tzeng et al., 2008; Wang et al., 2006), in supply chain management (Roh et al., 2009), in retail and ecommerce industry (Roh et al., 2009; Wamba et al. 2008), in air transport (Roh et al., 2009), in manufacturing (Roh et al., 2009), and other focused on the description of information system based RFID (Harry et al., 2007).

In his analysis of seven cases of RFID applications in seven industries, Roh et al., (2009) identified three key benefits of RFID adoption namely: cost savings, supply chain visibility, and new process creation. Then, they proposed a classification of RFID application based on two dimensions: scale (internal solo vs. internal multiple applications) and scope (internal integrated vs. multiple integrated applications). Roh et al. (2009, p. 363) concluded that the proposed classification helped organizations consider “which benefits they consider most important and thus which direction they should to take in RFID adoption”.

After analyzing five cases of RFID adoption in the healthcare sector in Taiwan, Tzeng et al., (2008) made several propositions to derive value creation from RFID: (i) implementation of RFID provides sources of value through new business opportunities; (ii) adoption of RFID and estimation of its effectiveness is not straightforward and is dependent on the analysis of many uncontrollable factors and the psychological climate of the organizations; (iii) evaluation of RFID applications need to be done from both strategic and operational viewpoints; (iv) implementation of RFID systems should consider stakeholders outside the organization’s boundaries, whose action may impact the organization; and (v) through RFID and the wireless sensor network environment, the meanings and constraints associated with location, space and time can be changed, so that RFID allows for new services to be created.

Wamba et al. (2008) analysed the application of RFID in four case studies related to four companies operating in the retail sector and concluded that cost reduction and expected benefit can be achieved if there are changes in business processes related to the supply chain members and these processes need to be integrated in a broader strategy.

Also, it is really amazing to observe that there is so little research into application of RFID in agricultural livestock, and those studies available focused on issues related to technology description: state of the art of transponders for animals, conditions for compatibility with future systems (Artmann 1999); description of requirements for a national identification and animals registration system (Wismans 1999); conceptual benefit-cost framework for evaluating the economic usefulness of improved animal identification systems designed to reduce the consequences of foreign animal diseases (Disney et al., 2001); development of a cost model to compare different
implementation strategies of the new European Commission regulation for sheep and goat identification and registration (Saa et al., 2005); application of RFID in animal monitoring including specification of RFID tags, standard, legislations and existing systems (Ntafis et al., 2008); RFID system description for brand authentication, animal traceability and tracking, (Alexandru et al., 2010); and platform description for livestock management based on RFID-enabled mobile devices in farms (Voulodimos et al. 2010). It is also surprising to note that case studies are totally lacking.

Per opposite to previous studies, this paper highlights a case study about the application of RFID which was performed at the Public Authority for Agriculture Affairs and Fish Resources (hereafter PAAF) in Kuwait. To better understand the case study, and before introducing the background of the PAAF, the following sections explain the economic situation and IT status in Kuwait.

**The economic situation in Kuwait**

Kuwait is a member of the Gulf Cooperative Council, (GCC), which is comprised of six countries, namely the Kingdom of Saudi Arabia, the United Arab Emirates, the Sultanate of Oman, Qatar and Bahrain. Kuwait is a geographically small country, occupying 17,818 km² and has a population of 3.4 million of whom 75% are foreign expatriate workers.

Kuwait is an economically rich country and a prominent member of the OPEC oil exporters, possessing approximately 10% of the world's known oil reserves. This is exemplified in Kuwait's 2008 per capita GDP which was approximately $ 37,855 with the value of its exports reaching $ 95.46 billion, and the value of its imports reaching $ 26.54 billion.

Kuwait, one of the richest countries in the Arab world, has a relatively open economy with proven crude oil reserves of about 96 billion barrels (15 km³). Petroleum accounts for nearly half of Kuwait's GDP, 95% of export revenues, and 95% of its government income. Industry in Kuwait consists of several large export-oriented petrochemical units, oil refineries, and a range of small manufacturers. It also includes large scale water desalinization, food processing, construction materials, and services such as banking and financial services.

Because of its lack of non-oil natural resources, Kuwait suffers from a major shortage in foodstuffs and fisheries mainly because of the lack of arable land, fresh water scarcity and harsh climate prevent the development of agriculture. Compounding these limitations, approximately 75% of Kuwait's potable water is either distilled as a by-product of electrical production at Kuwait's many power plants or imported via pipeline from neighboring countries.

Because of the fluctuations in the price of oil, the diversification of Kuwait's economy into manufacturing industries and food self-sufficiency, including agriculture and livestock animals, remains two long-term objectives for Kuwait's economy which is relies too heavily on oil.

The Kuwaiti government has experimented in growing food through hydroponics and carefully managed farms. However, most of the soil which was suitable for farming in the south central part of Kuwait was destroyed when Iraqi troops set fire to oil wells in the area and created vast oil lakes during the 1990-1991 Gulf War. After Kuwait was liberated from the Iraqi occupation in 1991, a great priority was placed on agricultural development so that Kuwait would have greater food security.
Since food security policy is one of the core strategies of any state, especially if it is rich as Kuwait, the Kuwaiti government initiated a feed program, under the patronage of PAAF which will be explained in detail further in this paper, which aims to encourage animal breeding, provides support and subsidies to farmers, and promotes better animal quality, all aimed at achieving greater food self-sufficiency. However, this program has been hampered and misused, which led to the introduction and use of RFID technology.

**Status of Information Technology in Kuwait**

Kuwait is the focus of this study because it is one of the few Arab countries that has achieved relatively high levels of Information Technology (IT) usage. For example, personal computer penetration in Kuwait was 24% in 2007 (ranked third after Saudi Arabia and the United Arab Emirates), and Internet penetration was 28%, (ranked second after the United Arab Emirates). Moreover, Kuwait has made systematic improvements and achievements in the process of automation within different public organizations, institutions, and ministries, which were initiated as early as 1999. These are considered key drivers toward enabling the implementation of an e-government strategy and electronic links between organizations.

With regard to RFID application and development in Kuwait, the outlook is encouraging. Kuwait has had several successful RFID experiences, such as with the Future Communications Company Global (FCCG), a company which specializes in selling mobile phones and has copyrighted several patents related to RFID innovations (e.g., inventory management, sale management, and customer service management). FCCG has also developed and marketed RFID software for inventory management and uses it to control the in and out flow of stock in its 30 stores in Kuwait. In addition, the Kuwait Ministry of Finance is currently under the process of assessing the benefits and applicability of RFID technology on millions of its paper files in order to avoiding problems related to file losses and wasted time search. Also, many university libraries in Kuwait have adopted RFID technology in order to improve inventory management, decrease theft, obtain instantaneous and accurate statistics, and reduce user waiting time.

**Overview of Public Authority for Agriculture Affairs and Fish Resources (PAAF)**

In the early 1950's with the increase of oil revenues, Kuwait started a program of modernization. Given the importance of agriculture, several sections related to this vital sector were established, including construction, health, public work, municipal, and social affairs. In 1953, the Department of Agriculture was established within the Ministry of Public Works, and its responsibilities consisted of overseeing all agricultural activities in Kuwait.

Also established in 1953 was the Agricultural Experiment Station which was the center of testing and research on plants, poultry and livestock. Its purpose was to select and adapt the best suited animals and species to the local Kuwaiti environment. When its activities expanded in 1968, the Agricultural Experiment Station was then converted to the Department of Agriculture Affairs, and later renamed the Department of Veterinary Medicine. Also in 1968, it was converted to the Department of Agriculture which, in 1979, was expanded to include the Department of Veterinary Medicine. In 1983, the Kuwait's Department of Agriculture was converted into a more independent institution named the Public Authority for Agriculture Affairs and Fish Resources (PAAF) (www.pAAF.gov.kw), which is the focus of this case study.
The PAAF is a governmental institution serving citizens, animal breeders and milk producing farmers. It has five main sectors (figure 1) that are each headed by a PAAF Vice-President: the Agricultural Sector, Plant Resources Sector, Livestock Sector, Fish Resources Sector, Greening and Beautifying Sector, and the Financial and Human Resources Sector. The PAAF is managed by the Board Chairman and Director-General, assisted by the five Vice-Presidents each heading a different sector. Six departments also report to the Board Chairman (figure 1).

Radio Frequency Identification (RFID) technology was implemented, as will be seen, under the Livestock Sector. This sector consists of four departments: the Animal Product, Zoo Management, Animal Health Management, Laboratories Management and Veterinary Research Department (figure 2).

**Figure 1: Organizational chart/ management structure of PAAF**

**Figure 2: Organizational structure of the Livestock Sector**

**SETTING THE STAGE**

*Objectives of the subsidies policy adopted by the PAAF*
Within the Kuwait's Five-Year Plan, the PAAF considers the development of the livestock sector (sheep, cattle and camels) of great importance. It gives, through the Livestock Sector, direct and indirect subsidies in the form of feed support for farmers and animal breeders, through its two departments: the Animal Health Management and Animal Product Department (Figure 3).

![Diagram](image)

**Figure no 3:** System thinking of different entities involved in the subsidy process

The PAAF supports both farmers and animal breeders with tangible and intangible resources. This is driven by several objectives: to reduce the cost of animal breeding, to improve and develop national livestock, to achieve the resettlement of local livestock, to achieve a minimum level of the country food security, and to reduce price of animal products through a series of policies and legislative actions. These legislative actions seek to provide a suitable and attractive environment for both livestock breeders and consumers.

PAAF’s policy for the development of the livestock industry extended the direct support into several other directions including organizing and extending the areas of animal husbandry, providing basic services such as farmers’ corporations, establishing infrastructure projects (e.g. gas, electricity, water and roads) and providing coordination with other institutions to ensure better implementation of these projects.

Also, the PAAF provides breeders with free vaccination, distributes almost free barns, and encourages the private sector to establish animal hospitals and veterinary clinics near animal breeding areas. It also organizes free trainings so that breeders can produce improved varieties of livestock. In addition, the PAAF provides government subsidies in the form of animal feed support. Although feed is mostly imported and subject to price fluctuations of world-wide market mechanisms, the Kuwait government, represented by PAAF, strives to stabilize the prices by subsidizing the feed price through a feed support program.

PAAF provides support for beneficiaries, which is obtained from the Ministry of Finance. The subsidy distribution process involves three sections within PAAF (i.e. Animal Support, Epidemic Control and the Veterinary Quarantine) and a local Kuwait company the Kuwait Flour Mills & Bakeries (hereafter KFMB) which is the only company that has control of the import and distribution of sponsored animal feed in
Kuwait. The PAAF conducts systematic monitoring to ensure the subsidies are received by real beneficiaries and increases accountability and transparency transactions with the Ministry of Finance. There are two types of subsidies oriented toward two different groups: (i) feed support for individual amateur breeders which include breeders of cattle, camels and sheep; and (ii) feed support for the union milk producers unions which produce milk for the local and export markets as well as poultry farms.

This case will address the evolution of subsidies solely in the first group, which includes feed support for animal breeders. It will explain what problems were faced, discuss the limitation of previous tracking programs to monitor the feed program, and explain why the use of RFID technology is justified. Such a focus is justified by frequent animal movements, difficulty in managing animal inventory, frequent selling and buying transactions leading to high fluctuations of livestock numbers, the dispersion of animal breeders in different geographical locations throughout Kuwait, and the existence of accounting manipulation and fraud in feed support distribution as will be detailed in the subsequent sections. The second group of farmer’s union milk producers is excluded from this paper because of its small size compared to those in the first group. This group lives in fixed places (i.e. farms), and the animals of this group are subject to continuous monitoring and supervision by the Animal Product Department thus they are easier to monitor and manage.

**Process of controlling the subsidies before the introduction of RFIDs**
According to Al-Ali Nabeela (2010), the Vice President for the Livestock Sector, "The policy to deliver state subsidies to animal breeders crosses four phases and all four failed to put an end to illegal activities of manipulation, abuse and fraud."

Before the 1980's, the PAAF used to provide full subsidies for all kinds of animal feed so that all such feed in the market were fully sponsored by the PAAF and were sold at less than their real cost.
Because of different forms of fraud (e.g. people who export and sell sponsored feed to neighborhood countries where the prices are higher or store high quantities until the prices go up), the PAAF started to orient the subsidies only to actual animal breeders. To achieve this objective, the PAAF requires animal breeders to issue a vaccination certificate from the Animal Health Management Department which verifies the recipient is an actual animal breeder. Based on this certificate, the PAAF issues a *feed support card* that states the exact number of animals the recipient owns, and enabled him to get the allocated quantity of animal feed support.

With the usage of paper certificates, manipulators started rotating animals among themselves in order to get vaccination certificates, necessary to issue feed support cards. To overcome the problem, the PAAF started using countermeasures and enforced the usage of *plastic ear tags*, a unique identification for each registered animal. This aimed to preventing re-vaccination and issuing another vaccination certificate for the same animal. Implementation of plastic ear tags, after Kuwait's liberation from Iraqi troops was outsourced to GRM International, an Australian based company (www.grminternational.com).

Because it was easy to remove the plastic ear tags and re-vaccinate the same animal several times for the benefit of receiving many beneficiaries, many unnecessary and fraudulent feed support cards were issued. This fraud caused the substantial wasting of public funds. Consequently, the PAAF replaced ear tags by punching the animal's ears with different shapes (e.g. a triangle, square, or circle) in order to distinguish
between vaccinated and non-vaccinated animals. However, animal breeders resisted against the idea and considered it as forbidden by Islamic Shariaa laws. This led the PAAF to issue a religiously based order (or fatwa) from the Kuwait Ministry of Awqaf and Islamic Affairs (www.awkaf.net) which allowed the process to continue.

Because of the difficulty in identifying the exact number of animals, the amount of state subsidies increased drastically between the years 2000 and 2009, most notably in sheep (table 2, figure 4). Highlighting this problem was the fact that farmers eliminated part or all of their livestock through sale transactions or slaughtering while continuing to receive feed support. Such corruption encouraged the widespread sale of subsidized feed on the black market, increased the number of vaccinated and registered animals by the PAAF, and increased the manipulation of feed prices due to an imbalance of demand and supply.
<table>
<thead>
<tr>
<th>Year</th>
<th>Sheep</th>
<th>Camels</th>
<th>Cows</th>
<th>Amount of subsidies (KDs)</th>
<th>Total subsidies (by tones)</th>
<th>% of amount increase between 2000 / 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2001</td>
<td>689581</td>
<td>4972</td>
<td>10875</td>
<td>2,299,619</td>
<td>NA</td>
<td>-</td>
</tr>
<tr>
<td>2001-2002</td>
<td>616521</td>
<td>4833</td>
<td>17721</td>
<td>2,850,000</td>
<td>400,220</td>
<td>23.93%</td>
</tr>
<tr>
<td>2002-2003</td>
<td>674123</td>
<td>5582</td>
<td>12638</td>
<td>3,679,971</td>
<td>423,044</td>
<td>60.03%</td>
</tr>
<tr>
<td>2003-2004</td>
<td>664140</td>
<td>24439</td>
<td>15208</td>
<td>3,200,000</td>
<td>236,804</td>
<td>39.15%</td>
</tr>
<tr>
<td>2004-2005</td>
<td>758114</td>
<td>48170</td>
<td>16238</td>
<td>4,283,925</td>
<td>297,865</td>
<td>86.29%</td>
</tr>
<tr>
<td>2005-2006</td>
<td>850992</td>
<td>12180</td>
<td>16813</td>
<td>3,200,000</td>
<td>278,147</td>
<td>139.15%</td>
</tr>
<tr>
<td>2006-2007</td>
<td>1175872</td>
<td>19075</td>
<td>16412</td>
<td>6,104,185</td>
<td>360,435</td>
<td>165.44%</td>
</tr>
<tr>
<td>2007-2008</td>
<td>926238</td>
<td>40683</td>
<td>22713</td>
<td>12,220,702</td>
<td>375,204</td>
<td>431.42%</td>
</tr>
<tr>
<td>2008-2009</td>
<td>1101959</td>
<td>38691</td>
<td>19454</td>
<td>31,883,803</td>
<td>465,816</td>
<td>1286.48%</td>
</tr>
</tbody>
</table>

*Table no2: Total animals and subsidies (amount and quantities) in Kuwait between 2000 and 2009*
Figure no 4: Evolution of number of type of animals in Kuwait between 2000 and 2009

**Process of getting subsidies before the introduction of RFIDs**

Getting state subsidies consists of several steps. First, the farmer makes an appointment with the Veterinary Preventing Section in the Animal Health Management Department to vaccinate his animals. This section issues a vaccination certificate within seven days. With the vaccination certificate, the farmer goes to the Animal Support Section within the Animal Product Department, in order to request the issuance of a feed support card. An employee at the animal support section checks the paper files and issues a feed support card, which is valid for one fiscal year. This card identifies the owner, lists his animals and the required feed support quantities. With this card, the farmer approaches the KFMB to get the allocated quantities of animal feed assigned to him once a month (table 3).

<table>
<thead>
<tr>
<th>Type of animals</th>
<th>Number of animals</th>
<th>Sponsored quantities distributed per month (1 bag = 50 Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>100</td>
<td>48</td>
</tr>
<tr>
<td>Cows</td>
<td>100</td>
<td>420</td>
</tr>
<tr>
<td>Camels</td>
<td>100</td>
<td>240</td>
</tr>
</tbody>
</table>

*Table 3: Sponsored monthly quantities*

The feed support card may be stopped or cancelled in some circumstances such as when animals go grazing outside Kuwait. This has been a common practice in Kuwait since weather conditions have made the pastures of neighboring countries, such as Saudi Arabia, more fertile than in Kuwait. This exit and entry process is strictly controlled by the Veterinary Quarantine Section of the PAAF and necessitates the temporary cancellation of the feed support card during the period of grazing outside Kuwait and an exit permit.

**Management and technical problems faced by PAAF before RFID implementation**

The distribution of state subsidies by the PAAF was hindered by many obstacles which resulted in both fraud and target beneficiaries not receiving their due subsidies. Before RFID implementation, there was no exact inventory of livestock because of manipulation and fraud. It was a common practice that animal breeders borrowed and
rotated animals among themselves in order to obtain vaccination certificates, thus getting unearned feed support cards. In other cases, breeders bought animals and resold them, after getting feed support cards. In such a case, they could continue to receive feed supports from the KFMB while reselling it on the black market. Such manipulations created inconsistencies in the animal inventory in Kuwait and mislead annual budget preparations for state subsidies. Such situations have led, according the Nabeela Al-Ali (2010), to insufficient amounts of feed support for some months, as she laments, “Subsidies budget are allocated for a full financial year starting from the 1st April of the current year to the 31st March of the next year, and the budget is approved and supported by the Ministry of Finance. And it happened in some past years that the budget did not cover few months of the fiscal year... which led to non satisfaction of breeders....this is why PAAF decided to implement RFID”.

Another problem faced by the PAAF was the difference between the number of animals reported by issued vaccination certificates and those effectively vaccinated because of a variety of fraudulent reasons. The absence of an effective information system and lack of automatic control over distribution of feed support cards accentuated and encouraged fraud. This situation worsened when some of the PAAF’s employees to issue feed support cards without vaccination certificates. During feed support distribution at the KFMB, some staff calculated the required feed quantities manually and then added additional quantities for their relatives and friends, beyond the maximum allowed quantities, or simply because of a lack of any control mechanism to check instantaneous feed support cards validity during distribution of feed support. The weak information technology infrastructure that links between various PAAF departments (Animal Health Management Department, Animal Product Department, Animal Support Section, and the Veterinary Quarantine Section) or to the KFMB contributed to the wasting of state subsidies and made the audit process very complex and time consuming.

Before 2001, the PAAF used MS software (Excel sheets Access) to develop independent applications for storage and processing subsidy data. These applications were developed within different departments and with different objectives, but the existence of these different applications led to isolated islands of information, which were very hard to integrate when needed. Moreover, because these applications were often developed independently, unplanned duplicate data files were the rule rather the exception. For example, the same data were stored about animal breeders in three departments and sections (the Animal Health Management Department, Animal Support Section, and Veterinary Quarantine Section). Limited data sharing was another limitation. Further, each application had its own private files, and users had little opportunity to share data outside their own application and department. It was often frustrating to managers to find that a report generated by an application (e.g. the number of vaccination certificates issued at the Animal Health Management Department) conflicted with another one (e.g. a report of issued feed support cards at the Animal Support Section). Finally, maintaining data about animal breeders in different applications was a complex process because of data duplications and frequent changes in the business (i.e. frequent transactions of buying and selling animals). This data duplication was wasteful because it required additional storage space and increased efforts to keep all the files up to date.

In order to overcome these problems, the PAAF converted MS Excel and MS Access applications into an Oracle database in 2001. Examples of these applications include the animals’ vaccination, the issuing of feed support cards, monitoring grazing
animals outside Kuwait, the distribution of allocated feed support quantities at KFMB and other transaction activities related to buying and selling of animals. However, the use of different identification numbers to distinguish animal breeders, such as old Civil I.D. numbers, driving license numbers, or medical insurance card numbers, made these applications not easily integrated. They also led to data conflict about subsidy beneficiaries, which was estimated at 30% of total subsidies by Mohamed Thamer (2010), a system analyst at the PAAF.

Another problem caused by these isolated applications, according to Mohamed Thamer (2010), was the issuance of fake vaccination certificates that were stored on these applications because they were controlled (through data input and modification) by the PAAF end user departments. Poor computer literacy of PAAF personnel in different departments also contributed to weaken the usage of these Oracle applications and made them less reliable and inefficient.

All these problems contributed to the widespread use of paper-based communication between the PAAF departments and between the PAAF and the KFMB. The use of paper communication, as opposed to e-mail, also contributed to data inconsistency, duplication and an increase in fraud.

The lack of accurate reporting and effective communication between the PAAF and the KFMB led to other problems. The usage of paper-based communication between the two organizations for audit and monitoring due payments (such as total due amount, distributed quantities, and beneficiaries) made this process complex and time consuming. According to Jassem Al-Qattan (2010), president of the IT group at the PAAF, “35 of claims billing boxed of due payment are received monthly by PAAF from KFMB company, and the process to sort, analyze and check those bills requires a period of nearly four months... In addition, the length of the audit process is causing confusion in closing the current fiscal year. And we complete the fiscal year with the presence of residual funds at PAAF which are not paid for the KFMB...This situation leads to problem in estimation of the budget of the new fiscal year”.

The PAAF could not even obtain accurate information about the status of subsidies. Accurate data of the inventory of livestock animals in Kuwait were lacking, as well as the exact distributed feed support quantities, and the exact number of animal breeders who need state subsidies. Even though the PAAF maintains communication with the KFMB, it could not verify the compliance of the effective distributed quantities of feed support by the KFMB with authorized quantities for each farmer. Disparity between the two quantities were a common practice since the KFMB may distribute fewer quantities to farmers than what were prescribed in the feed support cards, but claims all the amounts set forth in the card or simply the card was canceled, or suspended, or animals are sold, dead, or slaughtered.

CASE DESCRIPTION

To alleviate previous problems, the PAAF top management initiated RFID implementation program to provide managers with the tools and information to help them have better control of the subsidy process. In 2009, the PAAF issued a mandatory resolution forcing animal breeders to install RFID on all of the livestock in Kuwait starting April 1, 2009.

RFID background in Kuwait

RFID is an effective automatic identification technology for a variety of objects including natural artifacts, humans, and animals. RFID is a generic term for all the
technologies that use radio waves to automatically identify people or objects at a distance using an electromagnetic exchange. A typical RFID system is depicted in figure 5. Using RFID tags attached to an object or assets and a tag reader with an antenna and transceiver to gather the tag information, and then the data is sent to a host system with an enterprise system for further analysis.

![RFID components](image)

Figure 5: Components of an RFID system.

In Kuwait, the application of animal identification by amateurs dates back to 1969. The PAAF issued the first law regulating the possession of pets and obliged owners to implement plastic ear tags in order to follow up and monitor the spread of any animal diseases. Because of technological developments, owners of pets started implementing RFID at their expense in private animal clinics and hospitals. The implementation enabled them to monitor diseases and facilitate travel procedures because some countries require the existence of animal identification in the form of passports or microchips. Further, in 2007, the PAAF obliged amateur owners of all falcons to implement RFID tags.

Nabeela Al-Ali, currently the Vice President for the Livestock Sector at PAAF, introduced RFID application on all animals in the Kuwait Zoo in 2004 when she was the Zoo Director. RFID application was then extended to camels in 2005 because of ownership disputes between Kuwait tribes. Many tribes used camels for their daily life and travels before the oil boom, and the situation continued well afterward. Because of the multiplicity of tribes and properties, ownership disputes appeared from time to time (for example, Does this camel belong to the tribe "X" or "Y"? Does camel “X” belong to a Kuwaiti tribe or a Saudi Arabian tribe?). This is why Medhat Al-Alili (2010), an advisor to Nabeela Al-Ali, states, “RFID tags were first implemented on camels in order to settle down these problems and distinguish between the owners of the tribes as well as to defuse conflicts over properties”. Once RFID implementation succeeded, it was extended to all horses and then cows in Kuwait. There was an ongoing health research project based on RFID to develop new species of livestock on different PAAF farms; however, the implementation of this was not mandatory. After the success of the previous RFID implementation in animal identification, it was extended to all sheep and goats by a mandatory resolution on April 1, 2009.

**Technical solutions to limit/reduce the waste in state subsidies**

The PAAF had already tried several technical solutions to reduce manipulations and fraud of state subsidies which were discussed earlier. The failure of these attempts is why it turned to RFID technology.

**Use of RFID to better control the subsidy process**
RFID subcutaneous implementation was imposed on all kinds of animals in Kuwait. Such an implementation was and is a prerequisite to get feed support cards. In the early stage of the project, a steering committee was formed that included top managers from the four departments that belong to Livestock Sector. This committee planned and executed the RFID implementation and identified RFID tags specifications. To achieve smooth implementation of RFID implementation, the PAAF designed a database application that stores information about all animal breeders in Kuwait (e.g. names, mobile phones, and full contact addresses). One month prior to the start of RFID implementation (April 1, 2009), the PAAF sent several SMS reminders to animal breeders. The purpose was to urge them to start the RFID implementation on the due date and informed them that this was a prerequisite to get state subsidies. The PAAF also made available for private companies counters for selling RFID tags in veterinary clinics in different areas of Kuwait. In addition to these initiatives, PAAF top management initiated several awareness campaigns about the benefits of RFID implementations for both the state and the breeders. In order to ease RFID acceptance, the PAAF made the implementation free for animal breeders and assumed its implementation costs, and the process was outsourced to a local company through a bidding system.

Through RFID, the PAAF gathers data about the breeders (e.g. name, address, Civil I.D. number, mobile phone, etc.), animal information (e.g. the category of animals, number of animals, vaccination date, expiration of vaccination, etc.), and information about subsidies (e.g. identification of the feed support card, number of owned animals, authorized quantity of feed support, next vaccination date, date about exit animal to grazing outside Kuwait, etc.).

Besides these initiatives, the PAAF called companies, through local newspapers, to make available RFID tags for purchase on the local market. Until the end of March 2010, animal breeders are able to purchase RFID tags from five Kuwaiti companies and there was a gradual decline in the price of the tags since their initiation in April 2009 (from $5.18 to $2.93, which represents an almost 50% price reduction).

**Automation process and information system integration intra-department**

The PAAF achieved applications integration, based on Oracle solutions, between its departments involved in the subsidy process. Now data related to livestock vaccination, feed support cards and the exit of cattle to grazing outside Kuwait can seamlessly flow between involved PAAF departments/sections (the Veterinary Preventing, Veterinary Quarantine and Animal Support).

Because of Kuwait e-government initiatives, the PAAF started designing its Web portal in 2005, through the contribution of Aldiar United (www.duc.com.kw), a local outsourcing company. This project ended in early 2008. The PAAF’s web portal links different applications using common identifiers, such as the Civil I.D. number which is a unique number assigned to distinguishes all residents in Kuwait. This number eases data access to all applications from only one entry point: the PAAF web portal. It also enables and eases the workflow between various internal applications, thus eliminating paper-based communication, which reduced the immense amount of paper being passed back and forth between departments and animal breeders. It is also expected that the PAAF's web portal will be further integrated with other applications of Kuwait's e-government initiative. During August 2008, paper documents were stopped as a mean of communications, and data related to state subsidies were directly stored in Oracle databases through the PAAF's web portal. This automated the process
of issuing feed support cards that are now automatically printed without human interaction and include a serial number that uniquely identifies animal breeders, their number of cattle, and required support quantities. After the web portal implementation succeeded in controlling the process of saving, updating, and revoking vaccination data by PAAF specialists (database administrators and not by end-user departments) and making the change process very strict and controlled, fake feed support cards were eliminated.

In addition, data communication between the PAAF and the KFMB was improved. Now, the PAAF provides the KFMB with valid lists of subsidy beneficiaries and their authorized feed quantities (gathered through RFIDs) on a daily basis based on fax-modem technology transfer. However, the KFMB supplies the PAAF with account payables (due payment) every month by uploading data on the PAAF web portal or by sending data via a MS Excel file or on CD-ROM.

**Process of getting subsidies after RFID implementation**

Animal breeders buy RFID tags in accordance with the specifications set by PAAF. These tags need to comply with ISO 11787/11785 specifications and be approved by the International Committee for Animal Recording (www.icar.org). The serial number should not start with 999 since this number is for testing purposes, be resistant to high temperatures (above 50 degrees Celsius since Kuwait's summer temperature exceeds this level), and be closed and sterile. Once purchased, an employee from the Veterinary Preventing Section checks that the tags comply with the PAAF’s specifications. Then, the implementation is achieved by a local outsourcing company, the House of Development for Agricultural Contracting Company (www.kt-agrifood.com/house.htm) and the RFID implementation cost is assumed by PAAF.

Data related to vaccination is then uploaded into the Oracle database and a vaccination certificate with related information about the owner and his animals is issued and valid for one year. The same process, seen previously, is reinterred to get feed support from KFMB. In case the owner sells a vaccinated animal without the knowledge of the PAAF and the buyer (new owner) approaches the PAAF to revaccinate his animal, the seller's feed support card will automatically be suspended, so that he cannot get any feed support from the KFMB. Such decision is reconsidered once he approaches the Animal Health Department and then obtains another feed support card. The new card specifies the new number of animals he owns (previous one minus the sold one).

**Benefits of RFID implementation**

In accordance with Tzeng et al., (2008), benefits of RFID will be discussed from both strategic (PAAF upper managers) and operational viewpoints (breeders). RFID implementation serves both parties involved in the subsidies process. RFID enables animal breeders to receive feed supports and other subsidies. Vaccination certificates also entitle animal breeders to apply for low cost barns from the state. The vaccination certificate enables animal breeders to get authorization to bring cheap foreign labor force to Kuwait since this is conditioned and restricted by having a business activity.

As for the PAAF, RFID is useful and contributed to the three benefits highlighted by Roh et al., (2009), namely cost savings, process visibility, and new process creation. It becomes impossible to issue vaccination certificates without the implementation of RFID tags. Each animal was distinguished by a unique identification that is saved in the Oracle database. Such identification contributes to eliminate the duplication of vaccinations and ceases the past illegal practice of leasing animals to illegally obtain
feed. Thus, RFID contributes in creating a new process for control since it helps to determine with accuracy the exact inventory of livestock in Kuwait, which in turn contributes to provide the correct state subsidies. Also, RFID technology helps to regulate and control the delivery of state subsidies to only those eligible, which results in cost savings and reducing waste of public money. When issuing feed support cards, the Oracle system automatically calculates the amount of required feed support for each breeder depending on the number and type of cattle he owns, without amendment of PAAF staff thus contributing to increased process visibility. In particular, the number of animals and animal breeders were reduced compared to previous years (table no 4). Jassem Al-Badr (2010), the CEO of the PAAF states, “Before RFID, we suffered of waste in state subsidies because the subsidized animal feed was sold on the black market and because of the lack of accurate inventory of livestock in Kuwait. We succeeded to know the exact number of sheep, cattle and camels after RFID implementation. All these measures helped us achieve an abundance of state subsidies, and increased feed support distributed to breeders, and for the first time in the history feed support reaches more than 50%. Such benefit would encourage breeders to more acceptance of RFID.”

<table>
<thead>
<tr>
<th>Type of animals</th>
<th>Before RFID 1st April 2008 to 31 March 2009</th>
<th>After RFID 1st April 2009 to 31 March 2010</th>
<th>Rate of reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>5178</td>
<td>3154</td>
<td>-39.08</td>
</tr>
<tr>
<td>Camel</td>
<td>38691</td>
<td>25235</td>
<td>-34.77</td>
</tr>
<tr>
<td>Sheep</td>
<td>1101959</td>
<td>728404</td>
<td>-33.89</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of breeders</th>
<th>Before RFID</th>
<th>After RFID</th>
<th>Rate of reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows breeders</td>
<td>184</td>
<td>138</td>
<td>-25%</td>
</tr>
<tr>
<td>Camel breeders</td>
<td>1560</td>
<td>1054</td>
<td>-32.43</td>
</tr>
<tr>
<td>Sheep breeders</td>
<td>7554</td>
<td>5389</td>
<td>-28.66</td>
</tr>
</tbody>
</table>

Table 4. Livestock and animal breeders in Kuwait 2008 - 2009

Other benefits of RFID, that go beyond those highlighted by Roh et al. (2009), were also stated by PAAF top management including: planning animal vaccination campaigns, insuring food security planning for the country, identifying animal movement (from identity and country exit), and animal tracking to identify the owners in the cases of reselling, revaccination, or accidents on rural highways where animal such as camel frequently roam.

With regard to RFID implementation, Nabeela Al Ali(2010) states, “RFID project contributed to reducing the waste in public funds and state subsidies. It will facilitate the role of the regulatory, supervisory and monitoring of cattle’s health. It is also expected that RFID will contribute to prevent the spread of epidemic and infectious diseases during the movements of these animals from neighboring countries during the grazing movement”. She also added “I consider RFID implementation an excellent achievement and success. RFID helped the PAAF regulate the process of state subsidies distribution reduced the rate of manipulation that was a common and widespread before RFID implementation. RFID helps also the PAAF determine the exact number of types of animals in Kuwait, and contributed to the sufficient and abundance of allocated budget to support animal breeders. For the first time, the rate of feed support reaches 70% of the feed bag price, which is amounted $5.53 in Mars
2010. In addition, only real animal breeders, benefit now from the state subsidies”. With regards to the saved funds, she added that, “The evidence for the RFID success is clear. Unlike some past years, where the budgets were not enough and covered few months of the fiscal year, in 2009/2010, PAAF succeeded to cover the whole year. And we saved $10 million from the budget, which we translated in increasing the support for breeders/farmers”.

Youssef Al-Najm (2010), Head of the Animal Product Department at the PAAF, quoted “RFID implementation resolved several issues such as knowing the inventory of animals, and lessened frauds and manipulations. It also helped to reduce the waste in public subsidies and control the process of distributed animal feed support, plan vaccinations, and preserved the right of breeders to receive their monthly quota of feed support and the distribution of barns to beneficiary farmers. RFID also helped deter attempts of some breeders to increase the number of their animals through manipulations in order to obtain more state subsidies from PAAF”.

Hussain Nouri (2010), Head of the Epidemic Control Section at PAAF, emphasized the usage of RFID as chain visibility, and a useful new process creation, as saying, “The experience of RFID implementation helped speed access to accurate information about cattle. In addition, in case of traffic incidents caused by camel; and unlike past years where the identification process was time consuming, it is now easy to identify the animal and his owner”. He also stated other benefits, “RFID made possible to monitor animal’s health and when the next vaccination will take place”.

The usage of MS Excel file based CD-ROM as a mean of communication between the PAAF and KFMB also contributed to speed-up the audit process compared to paper based means; RFID accurate data stored in Oracle helped detect manipulators as well as or those who did not have valid feed support cards. Even though many benefits were achieved, the lack of and inconsistent communication between the PAAF and the KFMB is still is considered a problem.

Current challenges/ problems facing the organization

Electronic links and system integration between the PAAF and KFMB in order to check accuracy of account payable is one of the biggest challenges facing the PAAF. Based on the classification of Roh et al., (2009), the system addressed in the PAAF is still an internal solo application, and there is a need to extend its scope and make it multiple integrated applications based on its integration with KFMB system. Despite invested efforts by the PAAF “fraud and manipulation are still not 100% eliminated under different forms, and feed support is still sold on the black market” as quoted by Nabeela Al-Ali (2010), Vice President for the Livestock Animal. She also quoted that the PAAF is seeking more cooperation with the KFMB to the extent that it had submitted the request to making available its sales staff at the KFMB in the coming period. This aims to control daily operation of feed support distribution, check data accuracy of account payable, and the difference between effective and required quantities to be distributed in case the animal breeders decide to buy less than the maximum authorized quantities, as well as identities of those who received feed support. This raises the need to achieve system integration between Oracle database at the PAAF and Sybase at the KFMB. According to Jassem Al-Qattan (2010), President of IT Group at PAAF, such automatic link will allow information flow seamlessly between the two companies and contribute to audit the process on hourly and daily basis. After RFID implementation, the PAAF and KFMB have organized several meetings to achieve system integration in order to avoid usage of CD-ROM for audit
on account payables, as well as immediately stopping distribution of feed support cards that have been suspended or canceled by the animal product department. With this matter, Jassem Al-Qattan (2010) further explained “We were supposed to achieve electronic connectivity between systems of the two organizations, and we organized several joint meetings between managers of information system departments of the both organizations; but during the last meeting dated March 8th 2010, KFMB stopped the move toward system integration because of data confidentiality and security reasons”.

Political ramifications as well as the reluctance and resistance of animal’s breeders to implement RFID represent another important issue facing the PAAF. The adoption of RFID has been slow as many farmers are actively opposing it. This situation is not unique to Kuwait as it was also observed elsewhere in USA when the National Animal Identification System (NAIS) was implemented (FTCLDF, 2010). Reasons for this opposition are varied; some stemming from valid concerns while others come from misinformation and propaganda. The biggest concern of opponents to the RFID (from the perspective of animal breeders) is the cost to implement the program as well as health problems for the animals. The former was highlighted by several past studies that focused on voluntary (internal motivation) and individual use of IT in terms of the perceived cost of technology (Bertrand and Bouhard 2008), switching cost (Chang and Chen 2008), and perceived behavioural control (Ajzen 1991). All the three concepts refer to the perceptions of animal breeders of the high cost of tags, time and effort associated to switch from a situation without tags to RFID-based subsidy. The second has never been highlighted in previous studies. Unlike past studies, this result is new since the decision to implement RFID is not related to animal breeders themselves.

Nabeela Al-Ali (2010) categorized people’s reaction to RFID into three groups. The first group is breeders who are convinced about RFID, support and defend the implementation because of its perceived benefits. The second group is composed of breeders who are against the usage of any new technology and who exhibit high IT anxiety and claim that the implementation hurts animals and causes health problems (e.g. diseases, bleeding and infections). According to Al-Ali (2010), many breeders recognized that the industry has functioned without the RFID long time in Kuwait, and, therefore, they assume that the technology is not needed and it would add more expense for the producer. While cynics might see it this way, there is no way of knowing what the welfare issues are because the benefits of such a system are not yet known and shared by all breeders. The third group is composed of people who want the PAAF to assume RFID costs. According to their view, RFID implementation adds an additional cost to other expenses of animal breeding and point to the high cost of animal food and lack of pasture. According to anti-RFID farmers, the PAAF decision to impose its implementation is an invitation for breeders to leave the job and will stop small farm production. This may have strong strategic impact since it entails the possibility of Kuwait becoming fully dependent on import if animal breeders will put their threat into action. Continuation of sponsorship without RFID from the anti-RFID farmer’s perspective is therefore a strategic decision to make the country not fully dependent on animal import. They also added that many breeders do not have the money to implement tags on each animal, and many breeders went on strikes which were covered by local press. Mohamed Al-Baghli (2010), the President of the Federation of Livestock Breeders, was clear when he was quoted in saying, “Requested RFID tags are expensive for breeders. We made some suggestions for
PAAF management to assume full or part of its cost”. However, Jassem Al Badr (2010), the CEO of the PAAF is against such an argument and stated “The livestock sector did not impose the price of tags, and left to the importers to bring them from any place and at any price. At the beginning of the implementation, the price tag was $5.18. However, the cost is now approximately $2.9. We also asked the Federation of Livestock Breeders, traders and cooperatives, to help animal breeders and search for higher quality and provide them at reasonable prices”. With regard to the request to cancelling RFID tags implementations, Al Badr (2010) added, “The decision is irreversible, because we perceived RFID benefits, which led to the abundance of feed support, and we increased percentage of feed support for breeders during the fiscal year 2009/2010”. Nabeela Al-Ali (2010) supports the opinion of Jassem Al-Badr (2010) and added, “The cost of tags is not an obstacle to RFID adoption because tag prices are determined by the market demand and offer, and there are more than five companies that provide tags at affordable prices. Market freedom and the Authority's decision not to intervene in the price contributed to lower tag prices. In addition, PAAF already assumes cost of tags’ implementation through a third party”. She also explained that the PAAF is currently undertaking a study to determine the causes of breeders’ resistance to RFID implementation. This result confirms and clarifies what was found by Tzeng et al., (2008). The effectiveness of RFID introduction is not straightforward and is dependent on the analysis of many uncontrollable factors and the psychological factors such as the perceived cost, anxiety and political resistance to RFID.

Regarding the claim by breeders that RFID tags caused animal diseases, Youssef Al-Najm (2010), Director of the Animal Product Department explained, "This is not true, and after four years of RFID experience, we perceived tangible of tags benefits, as some breeders recognized themselves its importance. And a large group showed high cooperation with PAAF with regard to this matter".

Another challenge facing the PAAF is the lack of a complete annual statistical comparison between the period before and after RFID implementation. Nabeela Al-Ali (2010) recognized that the period of one year (1st April 2009 to 31 March 2010) is not enough to evaluate the return of investment and to assess other exact tangible benefits of RFID implementation. This requires more data collected over a longer period. Another issue is also related to the validity of vaccination card fixed by one year. Farmers may misuse this lengthy period by eliminating part or all of their livestock through selling or slaughtering the animals as soon as they get the feed support cards, ceasing the breeding activity while continuing to get state subsidies on monthly basis, and selling the feed on the black market.

The process of implementing new IT (RFID in this case) often fails to bring the intended result because the human dimension is not given adequate consideration. Before knowing if an alternative system might be better, one would have to know the costs and benefits of both systems. The biggest challenge facing the PAAF is to convince animal breeders that the difference in the amount they are paying for a bag of feed support (50 kg), before and after RFID implementation, is more than the RFID cost. This should further trigger PAAF’s top management to think about a broader strategy to guarantee farmers’ commitment to the new technology as Wamba et al. (2008) suggested.
Acknowledgements

This research was funded by Kuwait Foundation for the Advancement of Science, Research Grant KFAS 2010-1407-01.

REFERENCES


Al-Najm, Y. (2010), RFID benefits and challenges at PAAF. Interview with the Director of the Animal Product Department, April 5, 2010.

Al-Qattan, J. (2010), RFID benefits and challenges at PAAF. Interview with the President of the IT group, April 10, 2010.


Nouri, H. (2010), RFID benefits and challenges at PAAF. Interview with the Head of the Epidemic Control Section, April 5, 2010.


