

# **“Farm to Fridge”: Agriculture Extension, Dairy Development and Quality & Safety Monitoring**

To understand the status, structure and provide recommendations for the effective agriculture extension service, general guidelines for Dairy development and Quality & safety monitoring system.



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## **Abstract**

The report contains details on the agriculture extension (Animal husbandry extension service) and the Quality Assurance and control system in Nepal. The three months of Daayitwa Fellowship has been focused on the livestock extension service and Quality monitoring system of Nepal and India. The project aims to make recommendations for the Livestock services and Quality assurance and control system. This aims to increase the productivity in an environmentally sustainable manner, to improve producer’s incomes particularly those of smallholders, to rationalize the use of public resources in support of rural services and to make the effective quality monitoring system to insure the standard quality products to the consumers.

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## Acronyms

MOAD	Ministry of Agriculture Development
DFTQC	Department of Food Technology and Quality Control
DOA	Department of Agriculture
DLS	Department of Livestock Services
DDP	Dairy Development Policy
GON	Government of Nepal
TQM	Total Quality Management
FSIS	Food Safety and Inspection Services
GAP	Good Agricultural Practices
GVP	Good Veterinary Practices
GMP	Good Manufacturing Practices
GHP	Good Hygienic Practices
CAC	Codex Alimentations Commission

# 1 Executive Summary

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## 1.1 Background

Nepalese economy heavily relies on agriculture because it is the single largest contributor to GDP and is the major source of livelihoods of large number of people. And Livestock farming is one of the integral parts of Nepalese agricultural system. Although the dairy sector is growing faster and is a potential sector for foreign investment, the dairy value chain in the country has not been fully developed and organized yet. From the grass root level i.e. Farm to Fridge, each stage is in a crucial situation. Subsistence farming, traditional way of dairy management practices, scare feeding resources, very low average annual production (670 L/animal), high cost of production , insufficient skills and knowledge among farmers about dairy production & management, shortage of dairy animals, insufficient breeding bulls/AI services, insufficient accessibility to veterinary service, finance/loan etc. are some of the major problems at the production level .Centre oriented extension service and ineffective quality and safety monitoring system with lack of technical human resources are the rough road for the agriculture and dairy development in Nepal.

## 1.2 Methodology

The research study mainly relies on the sources of information from Ministry of Agriculture Development (MOAD), Department of Food Technology and Quality Control (DFTQC) and different stakeholders from Nepal.

I conducted field visit to DDC located in Kathmandu,Butwal and other private dairies .Along with this Formal and Informal discussion with the government officials, technical experts, academicians and dairy industry owners were also done. I researched and reviewed various literature, papers and official government policy papers.

## 1.3 Key Findings

- Livestock farming is one of the integral parts of Nepalese agricultural system and a major contributor to the agriculture GDP. The contribution of dairy alone is about 62.6 % of total AGDP.
- Only 15% of the farmers have access to the agricultural extension service
- Dairy Food safety from farm to Fridge; the body for monitoring and regulating this system has not been working in an organizational order.
- To provide consumer with safe milk products but the dairy industry has not adopted scientific and technical measures or control to ensure the quality standard product.

## 1.4 Key Recommendations

Although the dairy sector is growing faster and is a potential sector for foreign investment, the

dairy value chain in the country has not been fully developed and organized yet. The demand of milk & milk products is growing and will grow further. So from the grass root level systematic change has to be brought. Along with the best exercise in extension services there is effective way for dairy development with the strong regulation of safety and Quality monitoring system.

Some of the key recommendations are:

- Frequent change of governments has shifted policy priorities. Long term commitments in policy, strategy and funding are crucial for extension and industry sector.
- The traditional thinking of extension service as a state function has to change and mutually reinforcing roles of private and public services have to be emphasized.
- Market focused collaboration is needed among the stakeholders to minimize the existing problems of the sector and to strengthen the dairy chain.
- Capacity of research, education and training, and extension should be enhanced pursuant to goals of dairy development.
- The dairy product Regulation should be made more effective and strong supervision and Inspection of industry and market should be done with penal provision for violating the regulations.
- Those who engage in dairy product production activities must meet certain stipulated conditions and obtain a foodstuff production license and continual renewal and monitoring system should be implemented.

## 2 Introduction

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### 2.1 Background

Nepalese economy heavily relies on agriculture because it is the single largest contributor to GDP, generates direct employment to two third populations and is the major source of livelihoods of large number of people. Livestock farming is one of the integral parts of Nepalese agricultural system and a major contributor (27 % excluding processing industries) to the agriculture GDP. The contribution of dairy alone is about 62.6 % of total AGDP. The total production of milk in Nepal is about 1.45 million MT annually and the per capita availability of milk is around 52 lit/annum. The milk availability of 142.47 gm/head/day is quite below (50%) than WHO recommendation of 285 g/head/day. The country is currently facing the deficit of around 400 to 500 thousands litres of fluid milk daily which is fulfilled by importation of skimmed milk powder and reconstituted fluid milk. The demand of milk & milk products in Nepal is growing and will grow further.

Although the dairy sector is growing faster and is a potential sector for foreign investment, the dairy value chain in the country has not been fully developed and organized yet. Out of total milk supply in the country, only 15% passes through the formal channels. The sector is now facing many problems in each steps of production chain. Subsistence farming, traditional way of dairy management practices, scarce feeding resources, very low average annual production (670 L/animal), high cost of production (approx. Rs. 25/Litre), insufficient skills and knowledge among farmers about dairy production & management, shortage of dairy animals, insufficient breeding bulls/AI services, insufficient accessibility to veterinary service, finance/loan etc. are some of the major problems at the production level. From a recent study, it was found that majority of dairy farmers in Nepal are not practicing the method of clean milk production at farm because they are not aware about it and some of them are not following it because they are not getting any extra bonus for it and hygienic quality is not incorporated in the present milk payment system of the country. Even though the farmers’ practices are the most important entry points of bacterial contamination in the milk chain of the country, lack of chilling facilities in every collection centres, only one time (mostly morning) collection of milk, long way transportation of milk in ordinary vehicles, unhygienic handling during processing and distribution of processed products in ordinary vehicles were found important to flourish the bacterial contamination in the milk and milk products. Lack of mandatory rules and its effective implementation at factory level and its distribution channels are further deteriorating the quality of milk & milk products sold in the country.

Along with the unhygienic practices, the dairy farmer is unaware about the extension services that the government already set up for the upliftment of agricultural sector. As a result the improper methodology of farming and production of raw material occur which is unhygienic practice? Insufficient facilities and organizational set up and the access to information and access to animal health and breeding service at grass roots is another challenge that exists in our country for the development of dairy enterprise.

Market focused collaboration is needed among the stakeholders to minimize the existing problems of the sector and to strengthen the dairy chain further in the country. An integrated dairy industry incorporating the activities like improved livestock management/breeding, cattle feed production and processing of milk products with effective quality control system would offer promising prospects for profitable investment. There is an urgent need to analyze all the pros and cons of the problems and opportunities of the sector and efforts should be made by the concerned government authorities & other stakeholders to develop the sector further and to attract more investment in the sector.

## **2.2 Objectives**

The objectives of this project are:

1. To identify the major issues and challenges facing the Dairy development sector from the perspective of technology transfer.
2. To analyse and conduct research on existing Agricultural Extension services.
3. To analyse and conduct research on the regulations and acts related to food safety and quality control.
4. To identify the major gap and recommends necessary steps for Human resource development.
5. To carry out an assessment of the gaps, challenges and opportunities in the current dairy enterprises and entrepreneurs needs.

## **2.3 Research on the Vision of Dairy sector:**

To contribute to national economic development by commercially, qualitatively and competitively developing the dairy sector for employment generation and poverty reduction with the participation of government, cooperatives and private sector.



### **3.2 Present Scenario:**

The Animal Husbandry Extension services, unlike Agricultural Extension, have not been well organised and very often, are inseparable from the ongoing field activities such as veterinary health care and breeding services. As these services are demand based, most of the small livestock keepers, particularly those owning poor quality animals are excluded.

Government has established agricultural extension service offices in all 75 districts, only 15% of the farmers have access to their services. Similarly, 27% of the villages receive government supported veterinary services.

Livestock extension services are presently suffering from the inadequate extension machinery with lack of clarity (budget) and lack of coordination is current situation of Livestock extension services. With lack of participatory approach and lack of human resources and outdated approach is the scenario of the system.

### **3.3 Need:**

For effective extension service, clear extension policy based on ground realities should be formulated. Need to be tailor made for specific locations and target groups, based on the quality of livestock and capabilities of households. Extension programmes should focus on value chain development and need to reform the linkage and coordination between various institutions, with effective Public-Private partnership (PPP) to improve efficiency and productivity.

Need for revised focus on awareness about the problems and opportunities. Motivation of small farmers to adopt good management practices to optimise production, reduce cost of production and enhance profits is necessary. With the same approach we have to bring all the stakeholders on a common platform to improve the value chain and development of strong people’s organizations for self sustainability.

### **3.4 Strategy for strengthening Animal Husbandry extension service:**

- ✓ **Promotion of livestock keepers group**
- ✓ **Services through paravets and field guides**
- ✓ **Development of skilled human resources**
- ✓ **Strengthening of information services**
- ✓ **Strengthening the role of different department**

### **3.5 Livestock Extension**

Extension is the key to the success of livestock development, through active involvement of small livestock keepers, who are dominated by small, and marginal land holders, women headed families, poor and weaker sections of the society. As they are semi-literate or illiterate, disorganised and living in remote rural areas, special extension efforts are needed to reach them and communicate with them effectively. It is almost impossible to ensure effective transfer of technologies needed for enhancing the productivity of dairy animals, without an effective extension programme.

The Livestock Extension services include transfer of technology and strengthening of various infrastructure and support services, while building the capabilities of the stakeholders. The extension service should aim at assisting farmers through an educational process to improve livestock farming methods and techniques, strengthen the infrastructure and services to increase production efficiency and income, and enable them to enhance their quality life. The extension service should help farmers to identify and analyse their production problems and increase their awareness on the scope for improvement. It should motivate those who are hesitant and ignorant about the new technologies and systems which can improve the production and income. For the semi-literate and poor livestock keepers, the real extension service means hand-holding or mentoring till they adopt good practices and form a part of the value chain to realise maximum benefits. Presently mentoring of small livestock keepers is the weakest link in the value chain of livestock production.

### **3.6 Effective livestock Extension would include:**

1. Helping farmers to identify their production and marketing related constraints through awareness, exposure, exchange of information among other farmers, extension officers and other stakeholders.
2. Assisting farmers to make best use of the technologies and support services through capacity building.
3. Establishing linkage with information services on agricultural innovations, new technologies and market related information such as demand-supply and prices.
4. Building capacities and skills of farmers to empower them to adopt good practices for improving production while reducing the risk.
5. Promoting producers organizations to facilitate a platform for value chain and ensure involvement of various stakeholders to improve the production and profitability.

### **3.7 Changing livestock production systems and emerging constraints**

The demand for information on livestock production is growing, both in the sense of demands expressed by the producers themselves, and in the more general sense of a growing potential for increasing production through the delivery of information. Three linked factors are at play: processes of intensification and crop-livestock integration, increased commercialisation of livestock production, particularly in peri-urban areas; and the gradual overcoming of animal disease as a constraint on production.

### **3.8 Extension methods and institutions**

#### **3.8.1 Crop-based and animal health-based extension**

Despite its growing importance, livestock production extension is a field neglected both by policy-makers and by researchers. The importance of livestock to household welfare, fertility maintenance and production is still under-recognised in Nepal. But livestock production extension faces the additional institutional problem of being marginal to both agricultural extension and animal health services.

Agricultural extension services have developed around crop production, and remain tied largely to the seasonal nature of cropping. Such a system is less useful for livestock production, with a longer time-scale and a lack of synchronisation of different animals and herds.

Livestock services and the ministries or departments that are responsible for them, are mainly run by vets, and focus on animal health issues: curative treatment of individual animals, preventive health, and health screening of animal products.

While many special projects, area-based or sub-sectoral, concentrate on livestock production issues and are run by animal productionists, few countries can afford a *separate* livestock production extension service. Livestock production has often held a marginal status in official circles, between two well-defined sectors with associated interest groups, sometimes neglected by both, sometimes shuffled between them.

#### **3.8.2 Individual or group focus**

Group approaches are preferable where joint action is needed, or where free-rider problems need to be resolved in cost-recovery programmes. On the other hand, needs for information will be increasingly individual, as livestock production intensifies and becomes more complex.

#### **3.8.3 Information vs. information-with-inputs**

Extension can either provide pure information or information linked to material inputs. The latter can appeal to the commercial sector involved in input sales or marketed off take. It has also been

used in more remote areas by NGOs to give users a stake in the information system and to promote farmer-to-farmer spread.

### **3.8.4 Participation**

'Participatory' or 'farmer-led' extension have received much attention recently. While the need for farmer participation is real, the strengths of formal systems should not be overlooked: access to a pool of research expertise, systematic procedures for turning research findings into extension messages, and the fact that the organisation persists as messages come and go. By contrast, some advisory services, often run by NGOs, are based on predispositions with poor technical grounding.

## **3.9 Who manages extension?**

Besides national or regional governments, extension services can be run by NGOs, by cooperatives, by universities or research institutes and by the commercial sector. In India, some extension is provided through the system of dairy cooperatives, which reaches from village-level primary societies to a national federation, and has 8 million members. Primary societies are successfully delivering information both on business management and on technical aspects of dairy production such as use of green fodder and concentrates. But in Nepal still these services are limited to the departmental system not in the field.

## **3.10 Improving livestock production extension**

In the present climate of retrenchment, governments are unlikely to start creating new institutions, or funding new services, to deliver extension on livestock production, so this growing need must be met by reforms of existing institutions and services. In much of area of Nepal this will mean the national crop-based extension systems. But in all settings, participatory assessment of producers' information needs is essential before institutional forms are decided upon.

There is a continuing role for the state in providing extension, especially to poorer producers, and in areas where there are significant positive externalities such as those linked with soil fertility maintenance and resource conservation. Cost-recovery from poorer crop-livestock producers will be difficult to implement, but recovering costs from relatively wealthy producers (such as peri-urban fatteners or dairy farmers) may free public resources for extension to poorer producers.

### 3.11 Livestock extension within crop-based systems

At national level, relationships between agricultural extension services and livestock ministries or departments are inherently problematic. Livestock production is both a highly specialised sub-sector with a strong claim to separate structures, and sufficiently integrated with other forms of agricultural production to warrant inclusion in extension services. One part of the solution lies in decentralisation of all extension, and the integration of crop and livestock information delivery under local structures in response to local needs and conditions.

Most models for the integration of livestock into national extension systems will require cross-training of crop-specialist staff in livestock production and *vice versa*.

There are three linked but distinguishable imper-atives for livestock production extension: participatory needs assessment, responsiveness to inter-household variation, and ability to address information needs as they arise, not as determined by a calendar. In meeting these needs, livestock production extension must learn from 'farmer-led extension' initiatives but public sector reform is likely to be essential. Reforms to national systems can be incremental participatory needs assessment methodologies can be introduced, extension calendars compiled at lower levels, and treated more flexibly, and extension workers empowered to present options rather than set messages. But such reforms will require continued resourcing.

They will also require improved research-extension linkages. Here, livestock research may suffer from specific problems of:

- compartmentalisation and distance from the departments responsible for the linkages with extension;
- And under-developed methodologies for adaptive research and particularly participatory on- farm research.

### 3.12 Conclusions

There is increasing potential for improving livestock production through the provision of extension on production techniques. But livestock extension has been marginalised by major interest groups (crop-based extension and animal health services) and by a lack of a clear understanding of livestock farmers' needs. Crop production needs and animal health problems are more easily diagnosed and addressed than livestock production needs. Livestock farmers are frequently dispersed and are usually non-uniform in their needs (even within a particular community).

The sorts of reforms and modifications necessary to introduce some livestock production messages successfully into crop-based extension services are now clearer. Many of these reforms are needed anyway by those services if they are to work effectively with poor farmers. Other

information may be handled by animal health services, given certain reforms, particularly in professional reward systems. The choice of institutional context for livestock production extension cannot be made in the abstract, but has to be based on the nature of producers' information needs, and on available resources.

### **3.13 Policy conclusions**

- Choices can be made from a range of options for improving livestock production advice, depending on circumstances:
  - o links with agricultural extension services can be improved and crop/livestock information provision integrated at local level;
  - o links with veterinary services can be strengthened by providing production information from livestock health clinics or camps.
- In all cases, client-orientation needs to be stronger, with improved needs assessment and responsiveness to varied and changing farmer needs.

## 4 Dairy Development

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The primary drivers in dairy sector development include changes in demand, advances in production, transportation and communication technology, enhanced on-farm productivity due to improved management, and the expanding scope of dairy product marketing. However, a creative mix of sector policies and programmes that provide an enabling environment for sector development and private sector engagement can favourably influence the rate and shape of growth.

The financial resources commonly deployed by developed countries to support their heavily subsidized dairy industries are not available in developing countries. This absence of significant resources highlights the necessity for forging an enabling environment that is supportive of sector development through carefully crafted and focused policy interventions. These interventions should ensure engagement of the private sector through innovative partnerships, cost-sharing arrangements and meaningful participation of smallholders. In Nepal, where the majority of milk is sourced from smallholders with two to five cows, this requires a deliberate and creative development vehicle generated and endorsed through a carefully organized planning process.

During the project, the main task involves the reviews the general guidelines for dairy development planning. It includes discussion on possible policy objectives identified during the meeting with different stakeholders and review of tools and implementing mechanisms that can provide a road map for the action. The major assignments for the effective development of Dairy sector include the technical interventions that should enhance capacity and knowledge, productivity and competitiveness and market access.

### 4.1 Dairy Development Policy (DDP)

For more than 5 decades, dairying has developed in Nepal in absence of a comprehensive policy document. However, Dairy Development Policy, 2064 (2008), approved by GON, is now the guiding policy for overall development of the dairy sector. The policy is prepared in accordance to the spirit of Agriculture Perspective Plan (APP,1995-2015); National Agriculture Policy, 2061; National Milk Marketing and Strategy Study, 2001; and Agriculture Business Promotion Policy, 2063. Being based on these documents, all the aspects relating to dairy development in them have been incorporated in the policy.

The long-term vision of the policy is to qualitatively contribute to national economic development by commercially, qualitatively and competitively developing the dairy sector for contributing employment generation and poverty reduction with the participation of government, cooperative and private sector and extending the efforts and programs of making good quality milk and dairy products easily available to the consumers as a complementary to each other. The policy aims at increasing milk production and productivity; extending milk collection, transportation arrangement and processing industries; substituting import and promoting export of the dairy products; developing milk and dairy products; making milk and dairy products easily available to the consumers through quality improvement and regulation.

## 4.2 The pillars supporting dairy development

Human resource development and knowledge management	Improving productivity and competitiveness of smallholder milk producers	Strengthening linkages between farmers and consumers to deliver a quality product at a fair prices through:		
<ol style="list-style-type: none"> <li>1) Skills training</li> <li>2) Effective M&amp;E of sectoral development</li> <li>3) Support for regional collaboration in knowledge management through a smallholder dairy network.</li> </ol>	<ol style="list-style-type: none"> <li>1) “Menu of options” for dairy development models</li> <li>2) Selecting dairy development models appropriate for local conditions;</li> <li>3) Assist smallholder dairy sector to compete for resources</li> </ol>	<ol style="list-style-type: none"> <li>1) Improving farmer access to marketing channels;</li> <li>2) Strengthening price incentives to deliver quality milk;</li> <li>3) Creating competitive supply chain conditions;</li> <li>4) Creating fair and transparent pricing systems; diversifying the range of products on offer;</li> <li>5) Educating consumers on the nutritional benefits of dairy products;</li> <li>6) Stimulating consumer demand; and</li> <li>7) Reducing loses in the supply chain.</li> </ol>		
<table border="1" style="width: 100%; background-color: #e6f2ff;"> <thead> <tr> <th data-bbox="201 801 1396 853" style="text-align: center;"><b>Government &amp; Business Enabling Environment</b></th> </tr> </thead> <tbody> <tr> <td data-bbox="201 853 1396 985"> <ul style="list-style-type: none"> <li>•Supporting a smallholder inclusive policy framework;</li> <li>•Creating a legal and regulatory framework conducive for smallholder development;</li> <li>•Supporting the development of a favourable macro-economic framework.</li> </ul> </td> </tr> </tbody> </table>			<b>Government &amp; Business Enabling Environment</b>	<ul style="list-style-type: none"> <li>•Supporting a smallholder inclusive policy framework;</li> <li>•Creating a legal and regulatory framework conducive for smallholder development;</li> <li>•Supporting the development of a favourable macro-economic framework.</li> </ul>
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<ul style="list-style-type: none"> <li>•Supporting a smallholder inclusive policy framework;</li> <li>•Creating a legal and regulatory framework conducive for smallholder development;</li> <li>•Supporting the development of a favourable macro-economic framework.</li> </ul>				

But the identification of specific supportive activities shaping the broader context for intervention should be preceded by a development process that identifies the vision, goals, policy objectives and means of achieving these objectives. While commodity development can occur in a policy vacuum, driven primarily by economic, social and cultural factors, the broader development issues related to balanced growth, in particular smallholder inclusion in the process and poverty alleviation through dairy development necessitates a very strategic planning process.

## 4.3 Implementing an effective dairy development planning process:

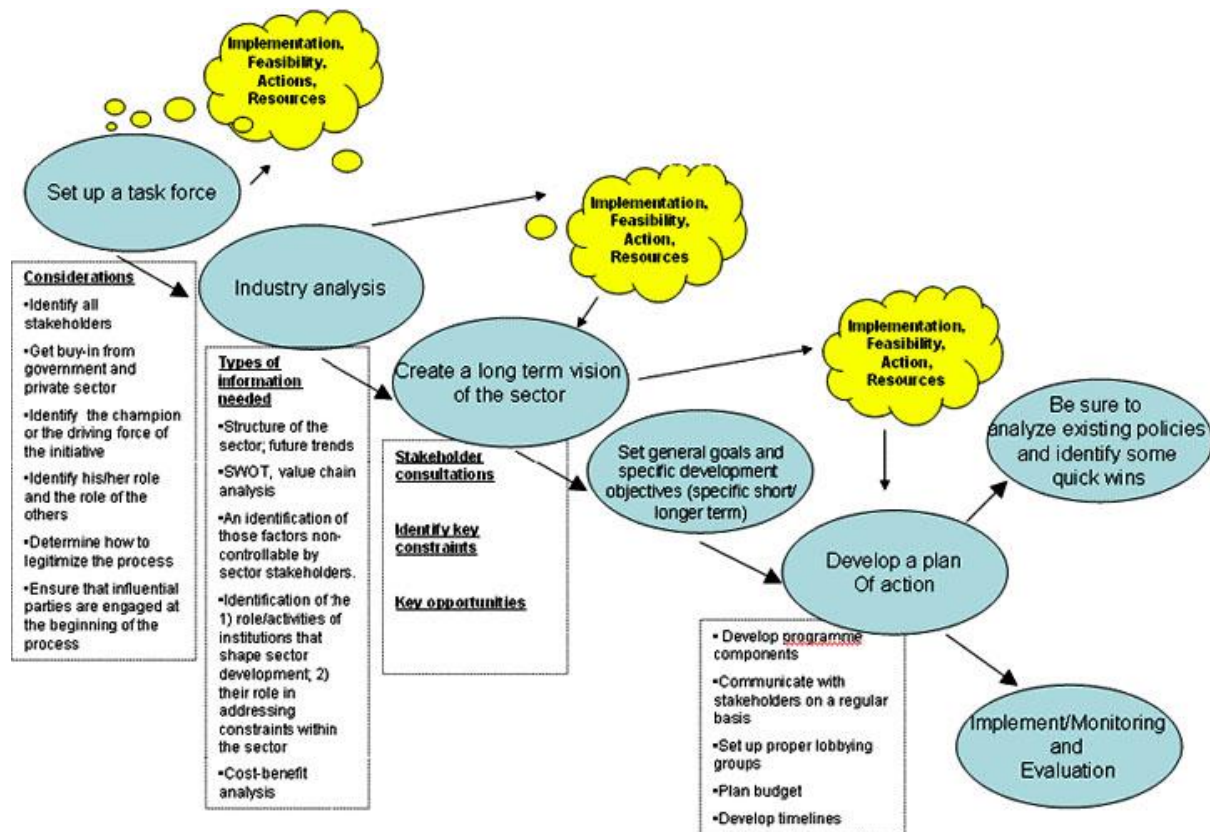
To provide better policy guidance to governments and dairy stakeholders the three month study and review identified the following good practices in sector planning:

1. **A stakeholder driven process** that involves consultation and political dialogue and engagement. The diverse nature of stakeholders along the dairy chain and their differing priorities needs to be considered when identifying and prioritizing strategic goals and objectives for sector development.
2. **The setting of clearly articulated measurable objectives** within the longer-term vision and goals for the sector. While the vision in many countries is focused on the development of an enterprise-based sector, it can also, depending on the context, recognize different production and marketing systems and include a pro-poor focus.

Strategic objectives need to be prioritized and identified as those focused on short-term outcomes and those that require long-term planning.

3. **Private sector-led orientation** that encompasses a focus on the entire value chain. This builds private sector buy-in to the process, thus ensuring viability and sustainability. But it also necessitates a good public perspective that draws into the process development priorities such as poverty reduction and environmental sustainability.
4. **Consistency** with previously agreed national plans and policies.
5. **A clear focus on implementation challenges**, with mechanisms built into the process to identify quick wins and to ensure that adequate resources are attached to various objectives. It also builds in a clearly articulated and time-based monitoring and evaluation system.
6. **A recognition that many of the specific solutions to constraints to sector development are outside the mandate of stakeholders**, including policy-makers, in the livestock sector. This includes policies influencing international trade flows, banking regulations, allocation of research and development funds, etc. These policies and regulations need to be analysed in terms of their impact on stakeholders in the dairy sector and advocacy needs to be developed to influence those policies.

#### **4.4 A generic approach for dairy development planning:**



A key priority in the strategic planning process is to identify and revisit the opportunities and constraints to implementation. The effectiveness of the plan needs to be linked to a clear recognition of resource availabilities/constraints (both human and financial), to demonstrate stakeholder commitment, particularly on the policy level and by private sector, and to an action plan accompanied by a specific time frame.

# 5 Quality control and safety Monitoring system

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## 5.1 Introduction

The Nepali Dairy Industry has acquired substantial growth in the recent years. Milk group contributes highest to the total output of the agricultural sector. Despite all these facts, we are not able to fulfil the demand and make a dent in the international market. The obvious reason for this is the quality of our raw milk and thereby the quality of the finished products. Most of the dairy plants are still sticking to the old system maintaining their quality, without considering the developments made in the tools to attain a consistent quality of any food product. Rising liberalization of agro-industrial markets and the world-wide integration of food supply chains require new approaches and systems for assuring food safety. At present, concern over food safety is at an all-time high. In response, the public and the private sector have developed new process standards and require suppliers of food products to follow them. Both, the market and legislations in importing countries demand for comprehensive and transparent schemes reaching from —farm to fork and —boat to throat. Organizations in the food sector will need to manage risk, demonstrate good corporate responsibility and meet legal requirements if they are to remain competitive, protect their reputation and enhance their brand. Hence, quality management tools like *Hazard analysis and critical control points (HACCP)*, *ISO 22000:2005 - Food Safety Management Systems*, Six Sigma etc are very much relevant in the present era of Globalization and aware consumers.

## 5.2 Importance of Chemical Quality Control in Dairy Industry

Milk is a highly perishable commodity. This perishable character of milk makes the life tough for the milk handlers, especially in the absence of proper infrastructure of cooling and erratic power supply. Since, dairy animals are fed on agricultural by products and crop residues, therefore the contaminant present in the animal get secreted along with milk in the form of pesticide and veterinary drug residues. These contaminants not only affect the health of the consumers, but also the quality of the products especially fermented products. Moreover, some of the unscrupulous persons involved in this trade are further tarnishing the image of Nepali dairy industry by adulterating milk with various chemicals, which are injurious to health. In the wake of all these facts, quality control of milk assumes very high importance and priority. The chemical quality control in dairy industry will enable the industry in the following ways:

- The strict quality control both chemical and microbiological will deter the adulteration of milk and will improve the quality of raw milk.
- The improvement of the raw milk quality through regular checks can improve the quality of the milk products prepared from such milk.

- It will install the confidence in national consumers, who are drifting away from the indigenous milk products.
- It will also increase the export potential of Nepali milk products, and finally the National image with reference to Nepali milk quality.
- The strict quality control will also increase the revenue of a dairy producer.

### 5.3 Quality Control and Quality Assurance

As per ISO: 8402 (1994): Quality is the totality of features and characteristics of a product or service that bear (determine) on its ability to satisfy stated or implied needs (requirements) ||

*Quality*  $\propto$  1/variability

—*Quality control* (QC) involves the set of activities used to ensure that the products and services meet / fulfill requirements for quality||

Traditionally Q.C is a laboratory function only and is related to analysis of samples i.e testing and judging of raw materials/ and finished products for acceptance or rejection.

#### 5.3.1 Purpose & Aim

To ensure that products are within the well defined and accepted standards thereby protecting the legal and health rights of consumers and financial interests of producers / manufacturers.

#### 5.3.2 Limitations

Recall of products is more because products are tested in the last stage or as finished products. This ultimately wears the impact on reputation of the company.

### 5.4 Quality assurance (QA):

QA is the set of activities which ensures that the quality levels of products and services are properly maintained and that the supplier and customer quality issues are properly resolved.”

Quality assurance gives adequate confidence that product or service will satisfy given requirements for quality.

### 5.4.1 Purpose/Aim

#### **Internal purpose**

Within an organization QA provides confidence to the management.

#### *External purpose*

Outside the organization provides confidence to consumers or others. Compared to QC, QA is much wider in the sense; it demands full control over the quality of raw materials, control over the process at different levels and control over distribution set up etc.

Notion is that “Prevention rather than Detection”. It is a proactive approach rather than reactive approach.

### 5.4.2 OBJECTIVES AND IMPORTANCE OF QUALITY ASSURANCE

To maintain legal standards and legal requirements —To fulfil customer’s requirement in terms of various attributes

- Physical (body, texture, colour, etc)
  - Chemical composition
  - Microbiological
  - Safety
  - Consumers should get what they pay for
  - This leads to increased consumer satisfaction and less complaints.
- 
- ❖ To check adulteration in incoming material in order to prevent substandard product, hazards or problems in the process
  - ❖ To check efficiency of processes: heating, cooling, removing hardness from water, effluent treatment etc
  - ❖ To safeguard nutritive value of milk and milk products
  - ❖ To check wastage of material
  - ❖ To help in research and developments
  - ❖ To ensure general cleanliness and sanitation in factory premises

### ***BENEFITS***

- Reduction in unit cost of production
- Reduction in wastage and scrape
- Less complaints from customer
- Avoids repeated inspection
- Increases production since rejection reduces
- Efficiency of unit goes up
- Management gets proud place in society
- Boost employee’s morale
- Reduction in production bottlenecks

## **5.5 Why focus on quality?**

### **1. Globalization/ liberalization**

Globalization has changed the way businesses are done. Availability of the number and variety of products has increased in the market. Several players including multinationals have entered into food business. This has increased the level of competition. If one has to sustain the competition he can’t do so with the substandard products.

### **2. Technological advances in food processing (e.g. Nanotechnology, Genetic engineering)**

The applications of modern science and biotechnology for food production and genetically modified foods and crops have presented novel opportunities and made enormous contributions in agriculture and food production. Certain technological development has also posed risks to food safety due to insufficient knowledge. Like Genetically modified organisms (GMO)/ Genetically modified foods and use of Nano technology for food production. These technologies are controversial and a cause of concern since we still have limited knowledge of their impact on human health for current and future generations and on natural ecosystems.

Advancement of technology has also affected food safety in positive manner. Development latest instruments like biosensors, Nano Sensors in Pathogen detection and various chromatographic techniques which helps in identifying food safety hazards.

Several advances made in the areas like maintaining nutritional quality, increasing the shelf life of foods, better transportation and storage facilities, better packaging materials etc. has potential to enhance the safety and quality of food.

Emergence of functional food is also an area which can affect the food safety. Due to their diversity all functional foods require a case by case evaluation for their safety.

### **3. New hazards and concerns**

Furthermore, higher levels of environmental pollution in our soil, water, and air are increasing the presence of contaminants such as toxic metals, dioxins, and polychlorinated biphenyls (PCBs) in food. Also, several substances designed to increase overall food production, such as insecticides, veterinary therapeutics, and hormones, are affecting the quality and content of food being produced, often with poorly understood long-term consequences.

In addition certain hazards like Bisphenol A in certain packaging materials (e.g. polycarbonate), *E.coli* 0157:H7, trans fat in formulated foods, acrylamide in fried products, fungal toxins like aflatoxin can affect food safety adversely and hence endanger quality of food.

#### 4. Increased consumer Awareness

Due to increased level of literacy and better communication facilities consumer has become aware and conscious about the quality and safety of food he/she consumes. Healthy, nutritious, safe and better quality products are therefore the need of the hour.

#### 5. Stricter regulatory frame works

Regulatory bodies of the worlds including Nepal are becoming stricter and science based. This has led to adoption of better processing technologies and measures which ensures good quality food to the consumers by food processor. New laws are passed considering new threats to the food safety and changed nature of food business worldwide.

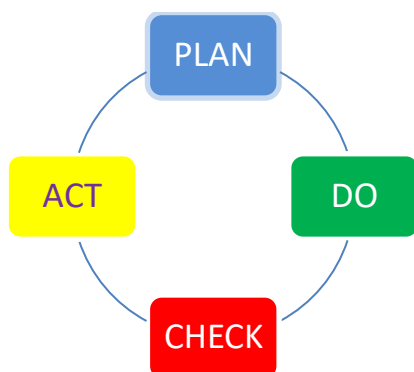
### 5.6 Model suited for Quality control

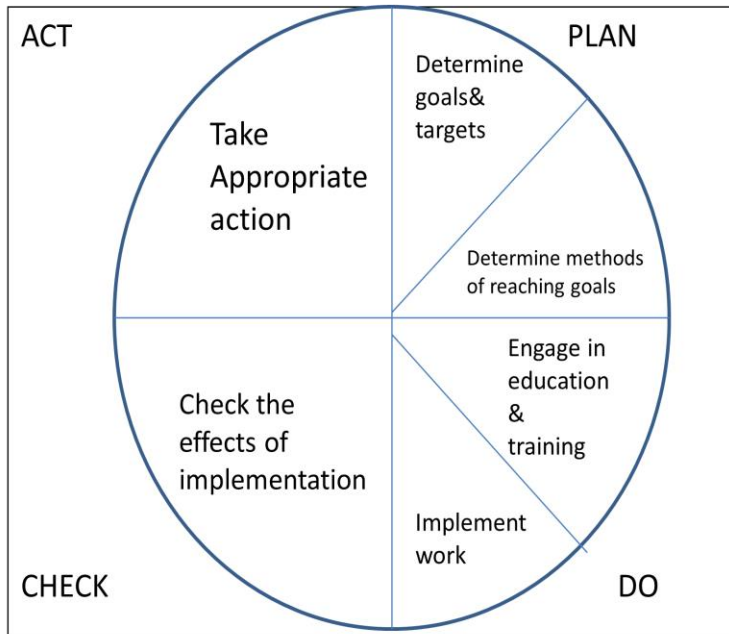
Deming’s Philosophy: Adward Deming proposed his concept of quality assurance. According to which, it involves both process monitoring and eliminating the causes of unsatisfactory performance at all stages.

- It is the name given to entire cycle of activities through which the fitness for use of process, product or service is achieved, with a view to carry out a company’s quality function in accordance with the laid down quality objective and policies.
- has divided quality control into four activities i.e.

1) Plan 2) Do 3) Check and 4) Act. Which is known as Deming’s PDCA cycle/wheel.

Deming wheel





**Plan**

- Establish goals
- Standardize working procedures
- Train employees

**Do**

- Carry out the work according to plan

**Check**

- Verify for compliance with the plan

**Act**

- In case of non-compliance, find out and remove its root cause(s)
- The Deming’s PDCA cycle applies to all situations and area where “quality control” is needed (wanted).
- it is the universal model and covers all activities relating to “Quality Control”, “Quality Assurance” as well as “Quality Improvement”.

## 5.7 Legal Standards

Legal standard means the specifications or the requirements which pertain to the law of the Govt. and are set up by the Govt. to meet certain minimum requirements in terms of chemical quality (i.e. composition), bacteriological quality (i.e. hygienic quality), and labeling and packaging requirements. Legal standards prescribe the minimum requirements for all types and categories of food. These standards are consistent with the minimum quality that is attainable under Nepali conditions by the majority of the farmers, producers, processors, sale agencies etc. Further, any food that does not confirm to the minimum standards laid down by the legal rulers is said to be adulterated, irrespective whether anything has been added to or removed from the original food.

### 5.7.1 Parameters Generally Taken into Consideration while Fixing Legal Standards

**Purity:** There should be a mention of purity in clear terms i.e. whether anything can be added or removed from the original food should be clearly specified in the rules.

**Composition:** Certain compositional criteria should also be clearly specified in the rules, as to what should be the minimum level of components in a given type of product. For example, fat and solids-not-fat content in milk, fat in whole milk powder, cream, paneer etc. Similarly, moisture in ghee, butter, skim milk powder etc. Likewise, all the compositional requirements should be specified for all the dairy products.

**Additives:** If any additives are required to be added to any food to improve its quality, stability, flavour etc, these should be clearly specified in the rules with respect to their levels etc. For example, certain additives are permitted like nisin (preservative) in cheese, BHA (antioxidant) in ghee, butter, whole milk powder etc.

**Efficiency of processing:** It should be clearly specified in the rules as to which types of tests have to be performed to check the efficiency of heat processing treatments given to milk and milk products. For example, phosphatase test should be negative for pasteurized milk; turbidity test should be negative for sterilized milk.

**Bacteriological quality (Hygienic quality):** Permissible limits for coliform count, total count, yeast and mould count etc should be clearly specified in the rules

**Packaging and labeling requirements:** There should be mention in the rules as to what type of packaging material is to be used for what type of food and what should be indicated on the labels like quantity, price, manufacturing date, expiry date etc. Now- a- days, nutritional facts are to be given on the labels.

## 5.8 Why Do We Need Legal and Quality Standards?

The main purpose of these standards is to protect the interest of the consumer, although in a way the interest of the manufacturer also gets protected, because if it is a certified product with some quality mark, it will sell more as compared to the uncertified product. Moreover, customer also wants to be sure about quality. He does not mind to pay a little more for an assumed quality product i.e. certified product. Furthermore, someone has to protect the interest of the consumer. They should not be left at the mercy of the manufacturers, because he is ignorant about the quality. Consumer should get a product of pure quality (i.e. unadulterated) free from pathogenic organisms and also free from harmful substances like pesticides, antibiotics, heavy metals (toxic metals like Arsenics, lead, mercury etc), and toxins etc. So, it is the duty of the Govt. to fix legal standards to protect the interest of the consumer and also to fix quality standards so as to improve the quality of the product to a higher degree above the minimum legal standards.

The main objectives of legal standards are:

- To protect the public from harmful and poisonous foods.
- To prevent the sale of substandard food containing harmful substances

## 5.9 Model for Quality Management:

### Total Quality Management (TQM)

- TQM may be defined as an integrated organizational approach in delighting customers by meeting their expectations on a continuous basis through everyone involved with the organization working on continuous improvement in all spheres namely-process, products and service along with proper problem solving methodology.
- Tools = SQC, QC, TQC, QA: often solve problem in one area of business such as quality of supply or excellence in manufacturing So what is required is ?

- a process designed to focus on customer expectation
- preventing problems
- building commitment to quality in workforce
- promoting open decision making

- ***TQM is a journey- it is the path as well as the goal.***

### Basic principles of TQM

- Be customer focused
  - place the customer at the centre of everything you do
- Do it right first time and every time- quality first and always
- Continuous improvement – by using the tool of PDCA in every aspect of work
- Communicate and educate
  - Improve communication means tell the people what is going on
  - Educate- train the people and retain them

—Measure and recorded

- While finalizing the goals, the Quality indicators (measurements) should be finalized.
- Record the measures as per prescribed documentation
- It allows the Department to make decisions based on facts, not opinion.

—Do it together- introduce team working

- Reduces conflict and in-fighting and increases trust and respect
- Bitting problems with wider range of skill – therefore better and more balance solution

### **Benefits of TQM**

TQM can bring several benefits for consumers, company and employee, if implemented properly.

#### ***For customers***

- Greater care
- Value for money
- Greater satisfaction
- Better availability
- Result in better customer loyalty.

#### ***For company (organization)***

- Continuous improvement in quality
- Reduction in cost
- Increase in productivity
- Better motivated work force
- Defects are reduces
- Faster solution of problems

Result in increased cash flow and net profit

#### ***for employees***

- Empowerment
- More respect
- More training and better skill
- Appreciation and recognition

The kind of interest presents the things are always be the issues of the customers affairs but keeping in mind that “Health is Wealth” ,each and every aspects of the quality should be in order to attain the

## 5.10 HAZARD ANALYSIS AND CRITICAL CONTROL POINTS (HACCP)

### 5.10.1 Introduction

The acronym HACCP, which stands for Hazard Analysis and Critical Control Point, is one which evokes 'food safety'. Originally it was developed to ensure microbiological safety of foodstuffs, but now HACCP has been broadened to include chemical and physical hazards in foods. The recent growing worldwide concern about food safety by public health authorities, consumers and other concerned parties, and the continuous reports of foodborne outbreaks have been a major impetus in the application of the HACCP system. HACCP is a systematic preventative approach to food safety that addresses physical, chemical and biological hazards as a means of prevention rather than finished product inspection. HACCP is used in the food industry to identify potential food safety hazards, so that key actions, known as Critical Control Points (CCP's) can be taken to reduce or eliminate the risk of the hazards being realised. The system is used at all stages of food production and preparation processes.

### 5.10.2 Necessity of HACCP

Food safety has been of concern to humankind since the dawn of history, and many of the problems encountered in our food supply go back to the earliest recorded years. Many rules and recommendations advocated in religious or historical texts are evidence of the concern to protect people against foodborne diseases and food adulteration. However, in recent decades this concern has grown. There are many reasons for this as follows:

- Foodborne diseases remain one of the most widespread public health problems in the contemporary world, and an important cause of reduced economic productivity, despite progress in food science and technologies. The *World Declaration on Nutrition*, adopted by the FAO/WHO International Conference on Nutrition (Rome, December 1992), emphasizes that hundreds of millions of people suffer from communicable and noncommunicable diseases caused by contaminated food and water.
- The increasing incidence of many foodborne diseases, e.g. salmonellosis and campylobacteriosis, in many regions of the world.
- Increased knowledge and awareness of the serious and chronic health effects of foodborne pathogens.
- The possibility of detecting minute amounts of contaminants in food, due to advances in scientific and analytical methods.
- An increase in the number of vulnerable people, such as the elderly, immune compromised individuals, the undernourished, and individuals with other underlying health problems.

- Increased awareness of the economic consequences of foodborne diseases.
- Industrialization and increased mass production, leading to increased risks of food contamination.
- The considerably larger numbers of people affected in foodborne disease outbreaks as a result.
- Urbanization, leading to a more complex food chain, and thus greater possibilities for food contamination.
- New food technologies and processing methods, causing concern either about the safety of the products themselves or the eventual consequences due to inappropriate handling during preparation in households or food service/catering establishments.
- Changing lifestyles, depicted by an increasing number of people eating outside the home, in food service or catering establishments, at street food stalls, or in fast-food restaurants.
- Responsibility for food preparation shared between family members who are not always aware of food safety rules.
- Increased worldwide tourism and international trade in foodstuffs, leading to a greater exposure to food borne hazards from other areas.
- Increased contamination of the environment.
- Increased consumer awareness of food safety.
- Lack of or decreasing resources for food safety.

In the light of the above reasons, there is a increasing concern about food safety, the lack of sufficient resources, and the recognition of the limitations of traditional approaches to food safety assurance which have accentuated the need for a cost-effective food safety assurance method. The HACCP system has proven to be such a system.

### 5.10.3 Principles of HACCP

HACCP is based around seven established principles.

#### **Principle 1**

**Conduct a hazard analysis:** Plants determine the food safety hazards and identify the preventive measures the plant can apply to control these hazards. A food safety hazard is any biological, chemical, or physical property that may cause a food to be unsafe for human consumption.

#### **Principle 2**

**Identify critical control point:** A critical control point (CCP) is a point, step, or procedure in a food process at which control can be applied and, as a result, a food safety hazard can be prevented, eliminated, or reduced to an acceptable level.

#### **Principle 3**

***Establish critical limits for each critical control point:*** A critical limit is the maximum or minimum value to which a physical, biological, or chemical hazard must be controlled at a critical control point to prevent, eliminate, or reduce to an acceptable level.

**Principle 4**

***Establish critical control point monitoring requirements:*** Monitoring activities are necessary to ensure that the process is under control at each critical control point. In the United States, the Food Safety and Inspection Service (FSIS) is requiring that each monitoring procedure and its frequency be listed in the HACCP plan.

**Principle 5**

***Establish corrective actions:*** These are actions to be taken when monitoring indicates a deviation from an established critical limit. The final rule requires a plant's HACCP plan to identify the corrective actions to be taken if a critical limit is not met. Corrective actions are intended to ensure that no product injurious to health or otherwise adulterated as a result of the deviation enters commerce.

**Principle 6**

***Establish record keeping procedures:*** The HACCP regulation requires that all plants maintain certain documents, including its hazard analysis and written HACCP plan, and records documenting the monitoring of critical control points, critical limits, verification activities, and the handling of processing deviations.

**Principle 7**

***Establish record keeping procedures the HACCP system is working as intended:*** Validation ensures that the plans do what they were designed to do; that is, they are successful in ensuring the production of safe product. Plants will be required to validate their own HACCP plans

Verification ensures the HACCP plan is adequate, that is, working as intended. Verification procedures may include such activities as review of HACCP plans, CCP records, critical limits and microbial sampling and analysis.

#### **5.10.4 Implementation of HACCP**

HACCP is a system that assists organizations to identify potential food safety hazards in the entire food supply chain and to take preventive measures for their control. HACCP focuses on the prevention of hazards rather than relying on end product testing. The following sequence of 12 steps, included in the guidelines developed by the Codex Committee on Food Hygiene, is the recommended approach to develop a HACCP programme.

##### **Step 1 Assemble HACCP team**

Set up a multi-disciplinary team that includes representatives from production, sanitation, quality control, food microbiology, etc. This team should be assigned specific segments of the food chain to be covered in the HACCP system, and be entrusted with developing a HACCP system as described from Step 2 onwards. Top management must give its full support to the team. If the required expertise is not available within the company, bring in help from a consultant.

### **Step 2 Describe product**

Draw up a full description of the product for which the HACCP plan is to be prepared, including product composition, structure, processing conditions, packaging, storage and distribution conditions, required shelf life, instructions for use, etc.

### **Step 3 Identify intended use**

Identify the intended use of the product by the end-user or consumer. You need to determine where the product will be sold as well as the target group (e.g. institutional catering, homes for senior citizens, hospitals, etc.)

### **Step 4 Construct flow diagrams**

You need to carefully examine the product/process and produce a flow diagram around which to base the HACCP study. Whatever the format you choose, study all the steps involved in the process – including delays during or between the steps from receiving the raw material to placing the end-product on the market – in sequence, and present them in a detailed flow diagram with sufficient technical data. In the diagram, you might also want to include the movements of raw materials, products, wastes, a plan of working premises, equipment layout, product storage and distribution, and of employee moves or changes.

**Step 5 On-site confirmation of flow diagram** The HACCP team should confirm the processing operation against the flow diagram during all stages and hours of operation and amend the flow diagram if necessary.

### **Step 6 List all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control hazards**

Using the flow diagram, the team should list all the hazards – biological, chemical or physical – that may reasonably be expected to occur at each process step, and describe the preventive measures that can be used to control such hazards (for example, the use of air curtains, hand feet washing at entrance to processing areas, wearing of head gear, use of good manufacturing practices [GMP]/standard operating procedures [SOP]/ sanitation standard operating procedures [SSOP], etc.)

### **Step 7 Determine critical control points (CCPs)**

You may wish to use a decision tree with “yes” or “no” answers to facilitate the determination of CCPs . When applying the decision tree, you need to remain flexible and use common sense to avoid, wherever possible, unnecessary control points throughout the whole manufacturing process. If you identify hazards at a step where control is necessary for safety and no preventive measures exist at that step, you need to modify the process at that step, or at an earlier or a later stage, to include a preventive measure. For example, in a slaughterhouse, covering carcasses with a sanitized cloth to prevent infection by flies is a preventive measure at the carcass stage, which substitutes for a preventive measure such as washing the prepared meat at the next stage, as it will not be possible to disinfect the meat at this stage, i.e., during cutting or mincing operations. ii) In dairy industry take the case of Paneer which contains as high as 70% moisture which is conducive for microbial growth. Studies carried out on microbial quality of paneer have indicated that it is often contaminated with Staphylococcus aureus and Coliforms. The HACCP has been applied to identify the Critical Control Point for Coliforms and Staphylococcus contamination. The analysis of various samples from raw material to the final product had

indicated that the contamination is due to food handlers using bare hands to remove the excess water in paneer (NIN, Hyderabad; Unpublished observations). The food handlers were informed about the importance of personal hygiene and they were asked to wash their hands with soap before touching the paneer, and the quality of paneer was tested after the intervention. Results indicated that cleaning of hands with soap before starting the operation drastically reduced Coliform contamination in the final product.

### **Step 8 Establish critical limits for each CCP**

You need to establish critical limits for each CCP. They are normally derived from specifications included in the food legislation of a country or in national or international standards (e.g. moisture levels in milk powder, or pH level and chlorine limit in potable water, etc.). When limits are not taken from regulatory standards (e.g. frozen storage temperature) or from existing and validated guides of good manufacturing practices, the HACCP team should ascertain the validity of such limits relative to the control of identified hazards and critical points.

### **Step 9 Establish a system of monitoring each CCP**

Monitoring is the scheduled measurement or observation of a CCP to determine conformance to its critical limits. The monitoring procedures must be able to determine loss of control, if any, at the CCP (e.g. improper control of the temperature that may lead to faults in the functioning of a pasteurization unit in a dairy plant). Monitoring for CCPs needs to be done rapidly, as they later relate to on-line processes, and there is usually no time for lengthy analytical testing. Physical and chemical measurements are often preferred as these can be done rapidly and can frequently indicate microbiological control of the product. The programme of observations or measurements should properly identify for each critical point

- Who is to perform monitoring and checking
- When monitoring and checking are performed; and
- How monitoring and checking are performed.

All records and documents associated with monitoring CCPs must be signed by the person(s) doing the monitoring.

### **Step 10 Establish corrective actions**

The HACCP team should develop specific corrective actions and document them in the HACCP plan for each CCP in the HACCP system so that they can deal with deviations when they occur. Such corrective action should include:

- Proper identification of the person(s) responsible for implementation of a corrective action;
- Actions required to correct the observed deviation;
- Action to be taken with regard to products manufactured during the period when the process was out of control and written records of measures taken.

The actions must ensure, for example, that the CCP has been brought under control, that procedures or conditions that created the out-of-control situation have been corrected, and the food affected, disposed off safely, etc.

### **Step 11 Establish verification procedure**

Develop a verification procedure to ensure that the HACCP system is working correctly. The procedure should include the frequency of verification, which should be conducted by a responsible and independent person. Examples of verification include auditing methods, random sampling and analysis, etc.

### **Step 12 Establish documentation and record keeping**

The HACCP system requires efficient documentation and accurate record keeping. For example, hazard analysis, identified CCPs and their limits (including revisions, if any) should be documented. Examples of records are CCP monitoring records, records of deviation found and corrective action taken on them, etc.

### **Assessment of Prerequisite Program Costs**

If a plant complies with General Manufacturing Principles (GMP's) and/or General Hygiene Principles (GHP's), the costs of prerequisite programs may be relatively small. In practice, most of the production facilities do not comply with existing norms. It is more economical to pay a fine (or bribe) than to invest in proper quality control and management.

Similar to other countries, expenses for prerequisite programs is the largest cost item associated with HACCP implementation. The expected total cost for these programs is around \$31,250 for an average dairy processing company.

However, this cost may be much higher if major construction or building remodelling, creation of stationary collecting points, or advanced lab equipment acquisition is necessary. Thus, the costs of prerequisite programs in Nepal are typically closer to those in developed countries (e.g. the US). When comparing dairy and meat processing industries, local experts noted that most of the cost items are similar in size and frequency between the two industries. In other industries these costs are expected to be lower.

### **Costs associated with HACCP development and implementation**

Overall, HACCP development and implementation includes a set of low cost activities including, for example, developing documentation, setting up the HACCP team and conducting regular meetings, training staff. The expected cost of these activities is around \$5,600-6,350. This cost may be larger if foreign consultants are involved. The development cost is not expected to be different among other industries.

### **Recurring (operational) HACCP costs**

Similar to development costs, operational costs are also low. The expected first year operational cost is around \$6,250 and is related primarily to the number of Critical Control Points (CCPs) that are established according to the HACCP plan. The operational costs tend to decrease over time by approximately ten percent after the first year and, in some cases, by another five percent after the second year. This decrease is associated with a decline in the number of the CCPs and the learning effect.

The overall expected cost of HACCP implementation in Nepal is similar to other developing countries and usually is less than in more developed economies like the United States. The largest component is the cost of prerequisite programs.

Benefits for enterprises

The most important benefit associated with HACCP implementation is access to new retail chains and supermarkets. An expert from the dairy industry states that the widespread adoption of HACCP could double sales in this market segment. This benefit is stated as a primary reason for adopting HACCP by domestic enterprises.

Also, experts have mentioned that there is an increasing pressure from the supermarkets regarding adoption of HACCP by their suppliers.

Increases in prices and profitability are often considered as another important motivation for implementing HACCP. Regarding other benefits, they are less important for the dairy industry in Nepal. Access to international markets is thought to be not feasible for domestic dairy industry due to a lack of quality raw milk. While for other industries the pull of export markets is among the most important benefits.

Other benefits include decreased frequency of certification, lower insurance cost<sup>8</sup>, improvement in control and overall management of production process. Liability for the damage caused by food-borne diseases is not thought to be an important cost/benefit factor in Nepal. However, cost savings due to the early detection of unsafe (e.g. contaminated) products can be substantial if compared to the late detection or reclaiming and re-processing.

### **5.11 A low-cost sensing system for quality monitoring of dairy products**

The dairy industry is in need of a cost-effective, highly reliable, very accurate, and fast measurement system to monitor the quality of dairy products. Dairy operations can be viewed as a system of processes directly or indirectly impacting one another and ultimately creating the quality of the end product, raw milk. This makes the quality of the milk produced on a farm a reflection of the performance of all the processes that constitute a dairy operation. Therefore monitoring that quality is critical for the herd manager and all employees to know how the herd is doing.

Dairy managers receive data on a daily basis regarding dairy productivity and quality. However it is often difficult to take full advantage of this information. Test results in the form of rows and columns of numbers are hard to read or interpret. Summaries in the form of monthly or yearly averages enable us to compare one month or year to another. They do not however help us distinguish between natural month to month variations and/or notice a trend that we should be concerned about. In addition, these summaries usually come too late and are therefore taken out of context making it hard for a herd manager to tie any shift in fat, protein or SCC to a specific day, event or change on the farm.

Daily monitoring of milk quality represented in a more "comprehensible" form than tables of numbers would help provide information about herd's past, present and future performance in time for managers and other dairy employees to make appropriate decision.

Statistical process control (SPC) is a tool that has been used for a long time in manufacturing industries to manage quality. SPC measures process behavior with control charts. It looks at the operation as a system of processes and allows us to know when real change has occurred. By examining a control chart we are able to answer one very important question: Are we improving, staying the same, or getting worse? The sole purpose of SPC techniques is to allow production managers to distinguish with statistical certainty the difference between "normal" (common cause) and "abnormal" (specialcause) variation.

Recently these techniques have been adapted and applied to the dairy industry. Daily and weekly herd management data can be graphed into easily understood control charts that provide powerful day-to-day decisions aids. The steps to develop a control chart are as follows:

- 1) Start with a time series chart.
- 2) Add a centreline for central reference
- 3) Add control limits computed from the data
- 4) Apply tests to distinguish real change from random variation

If we look at a dairy operation as a system of processes we will find that there are numerous applications for SPC in dairy herd management; from monitoring feed intake, health or reproductive performance to milk quality monitoring. On most dairies, daily milk quality data are readily available, but the rows and columns of numbers can be overwhelming and make it difficult to draw any conclusions. Looking at a chart, however, makes it easier to identify where the process is heading.

## **5.12 Ensuring food quality and safety**

Ensuring an acceptable level of food quality and safety is necessary to provide adequate protection for consumers and to facilitate trade. These objectives can be achieved by implementing and monitoring quality assurance measures along the entire food chain, when it is appropriate and when it is possible. Everyone involved with food, from the farmer to the consumer, shares in the responsibilities to keep the food supply safe by taking the necessary precautions to keep food protected from hazards that can increase human health risks. These actions will also prevent or reduce food losses, which is especially important in those situations where food security is threatened.

### **5.12.1 GOOD PRACTICES IN CROP AND ANIMAL PRODUCTION**

Implementing quality assurance measures starts at the farm with the application of good agricultural practices (GAPs) and good veterinary practices (GVPs). GAPs are those practices that enhance the production of food that is safe and of good quality, that are environmentally sound and that ensure appropriate handling, storage, shipping and management of the product. When GAPs are appropriately applied to the production of primary food crops, consumers can be assured that the food will meet quality and safety standards at the time of harvest

In much the same way, GVPs have been established to assure consumers that foods derived from animals meet acceptable levels of quality and safety. These practices are the guiding principles in professional veterinary practice for the care and treatment of animals, including animals used for human food production.

When appropriately applied, GAPs and GVPs can protect food at the primary stage of production from contamination by extraneous materials (filth, putrid or decomposed materials, rocks, dirt and sand); toxic chemicals and contaminants from the environment (heavy metals, environmental pollution and industrial chemicals); excessive or unsafe levels of agricultural chemical residues (pesticides, fertilizers, veterinary drugs and other chemicals); contamination or damage by pests, insects and vermin; and biological contamination by mould, pathogenic bacteria or viruses - any of which can cause spoilage, crop damage and foodborne illness or chronic health consequences in humans. Increased human health risks may also result from consumption of animal products if animals have been fed contaminated feedstuffs which carry over into edible meat products.

### **5.12.2 GOOD PRACTICES IN PROCESSING**

The quality and safety of food intended for manufacturing or processing can be ensured by applying good manufacturing practices (GMPs) and good hygienic practices (GHPs) to food processing. When properly applied, these measures ensure quality and safety for all the processing or manufacturing steps from the receipt of the raw materials (primary products and other ingredients) to the shipping and marketing of the final products to the consumers.

Implementation of GHPs entails the use of appropriate sanitary measures to prevent microbial contamination and assurance of optimum sanitary conditions for processing food products. GHPs involve:

- the use of appropriate cleaning and sanitizing techniques, including the use of approved and effective agents used at the proper level (strength, concentration) and frequency to prevent microbial buildup on processing equipment and utensils or other food contact surfaces;
- observation of sanitary practices, use of protective clothing and strict observation of rules of personal hygiene by personnel involved in handling and processing food;
- the use of hand-washing and hand-sanitizing dip stations when and where appropriate;
- having time and temperature controls in place to prevent microbial growth in the susceptible intermediate and finished processed foods;

- The use of other sanitary measures that are specifically needed because of the nature of the food being processed, the processing technology or the facilities in which the processing takes place.

GMPs include measures ensuring that:

- food materials and ingredients, including food additives, are of the appropriate level of quality and safety before use and are stored properly to prevent contamination and mix-up with other processing material;
- facilities used in food production are of the appropriate size to prevent overcrowding and to allow proper placement and orderly storage of equipment, raw materials and other product materials such as packaging and labelling;
- layout of facilities permits the orderly flow of production materials and personnel in processing;
- facilities are suitably lit;
- equipment is maintained for proper functioning;
- temperatures, times, pressures, machine operations and other processing parameters are controlled at the specifications level required to assure proper processing;
- appropriate labels are used.

These control procedures also include the examination or sampling of intermediate foods from the processing lines and finished foods from final storage. The products are examined or tested analytically for compliance with product specifications and quality and safety requirements.

When properly applied, GMPs also include the establishment of record-keeping systems for recording the results of quality control activities. Information that might be recorded includes:

- results of quality assurance personnel inspections of production facilities prior to and during production;
- processing parameters during food processing (cooking times, temperature recordings, pressures);
- results of specific methods or procedures for on-line product examination (net weights, can seal tear-down);
- results of examination of the integrity of the package closure systems;
- Specific laboratory analysis methods to be used for quality and safety determinations, sample size and established criteria for acceptance or rejection of the lot.

Some food processing methods are very complex while others are relatively simple. Each process must be carefully assessed as to its potential for the presence of foodborne hazards and for the impact on food quality and safety if processing failure should occur, which may at times create unacceptable levels of risk for consumers.

### **5.13 Safety control procedures**

In some cases, because of the nature of the food processing methods or the hazards associated with some foods, consideration is given to applying intensified safety control procedures or

systems. One such system is that based on the Hazard Analysis and Critical Control Point (HACCP). In order for the HACCP system to be effective, there must first be an effective GHP and GMP system in place.

In manufacturing and processing of foods it is also necessary to ensure the safety of ingredients used as technical aids, additives, flavourings or colourings. Such safety assessments require the analysis of test data, chemical specifications for substances involved and information on human dietary consumption levels and patterns. It is also necessary to evaluate the impact of uncertainties in cases where the information is insufficient to make a clear safety assessment decision. This is the work of highly trained specialists in toxicology, nutrition, chemistry, food composition and risk assessment techniques. The necessary expertise is often found only in countries with highly trained personnel and advanced technological capabilities.

## **5.14 TECHNICAL ASSISTANCE NEEDS**

Food technology and science are complex, involving specialized knowledge in a wide range of fields such as chemistry, biochemistry, physical chemistry, microbiology, nutrition, toxicology, physics, radiology, statistics and mathematics. As a consequence, food control measures are diverse and complicated. The technical dimensions are different for nearly every food product, for the various technologies used in food preparation, processing and manufacturing and for the various types of facilities in which food is produced.

In view of the many food safety concerns of consumers and the diversity in scope and dimensions of food quality and safety problems, technical assistance is often needed. Furthermore, new food products are created every day and new technologies are being developed and introduced rapidly, so the demand for keeping up with the scientific advancements in food technology is high. Emerging hazards such as antibiotic-resistant microbes and novel pathogenic bacteria present food control officials with new challenges in maintaining controls to ensure public health. With rapid shipping methods and the global distribution of food, serious public health risks and food hazards in one part of the world can be transferred to other parts of the world in a matter of hours or a few days.

Consumers expect government to look after their interests in making sure that the food industry produces safe food and that economic fraud, unfair trade practices and risks to human health are minimized. Government frequently does not have the financial and technical resources to provide such assurance, especially in developing countries. Many developing countries lack access to the latest knowledge and information about new food processing technologies. They may also lack technically trained staff, equipment, methods and facilities for testing or analysing food for contaminants, toxins, chemical or drug residues or microbiological contamination.

In our country, there is a need to update and revise the existing legal framework regarding food quality and safety. Regulations governing food standards are often lacking or outdated. Food control infrastructure may be non-existent, poorly organized or inadequately supported because of the lack of sufficient financial resources. In Nepal, different government ministries or agencies are involved in food regulation and control, but their failure to coordinate their activities results in a waste of resources because of overlapping and redundant work efforts. There is

generally a need for improved regulatory food inspection and laboratory services, development of food control enforcement programmes and the administration and coordination of food control activities in developing countries. Training in technical areas of food control is nearly always needed in our country.

### 5.15 **QUALITY AND SAFETY MONITORING IN DAIRY INDUSTRY**

Current awareness on quality and safety of dairy foods; consumer awareness and their demands for safe foods; role of Codex Alimentations Commission (CAC) in harmonization of international standards; quality (ISO 9001:2000) and food safety (HACCP) system and their application during milk production and processing. National and international food regulatory standards; BIS, PFA, ICMSE, IDF etc., their role in the formulation of standards for controlling the quality and safety of dairy foods. Rapid assessment of dairy food for microbial and non-microbial contaminants; Enumeration Principles in detection of predominant spoilage organisms and pathogens like indicator organisms, E.coli, Salmonella, Shigella, Staph aureus, Bacillus cereus and non microbial contaminants like antibiotic residues, aflatoxin, pesticides other inhibitors etc from. dairy foods and their control measures. Microbial quality of water and environmental hygiene in dairy plant; chlorination of dairy water supply, quality of air. Personnel hygiene, treatment and disposal of waste water and effluents; setting up of a microbiological/ pathogen lab in a dairy plant and its safety concern.

## 6 Recommendations for scientific and effective Quality and Safety monitoring system

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1. The Government of Nepal should develop a clear policy to encourage and support the implementation of internationally recognized food safety management systems at all Nepali food enterprises through various incentives, such as decreasing the frequency of inspection visits to facilities with HACCP-based system and building consultation capacities of control authorities to help to introduce best food safety solutions and practices.
2. Structural reform of the inspection system should be based on results of a public-private dialogue with the food processing industry, consumers, and exporting countries.
3. On the national level health statistics need more detailed breakdown of food-borne diseases and more efforts to ensure better reporting and monitoring system of food safety issues. That will help official control authorities to identify causes of food outbreaks and prevent them through support and proactive implementation of food safety management systems in food business operators.
4. Obtain or generate the best scientific knowledge through the use of laboratory or field studies, risk assessments, and similar food safety tools.
5. Minimize knowledge gaps by conducting pilot programs of the proposed performance standard, by maintaining databases of critical information, or by conducting risk assessments that can be used to develop performance standards, and by including science-based expertise if needed.
6. Interaction and public Awareness program for quality and safe food products.
7. Capacity of research, education and training, and extension should be enhanced pursuant to goals of dairy development.
8. The dairy product Regulation should be made more effective and strong supervision and Inspection of industry and market should be done with penal provision for violating the regulations.
9. Those who engage in dairy product production activities must meet certain stipulated conditions and obtain a foodstuff production license and continual renewal and monitoring system should be implemented.
10. Accredited laboratory services with qualified manpower for export promotion are needed. So the concerned Ministry and authority should deploy the program necessary to ensure this system.
11. Expand the structure and function of Department of Food Technology and Quality control.

12. Technological innovation in processing and manufacturing segments and monitoring & safety segments.

## 7 Recommended Reform Measures for Relevant, Effective and Efficient Agricultural Extension Services:

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The extension system includes a complex network of institutions and the reform process should be expedited for a more viable extension system. There can be no blue print for generalization as the farming systems are diverse and microenterprises potentials are many. Therefore, the process to address needed reform to ensure an efficient, effective and relevant extension system should give due consideration to the following:

1) Frequent change of governments has shifted policy priorities. Long term commitments in policy, strategy and funding are crucial for extension services performance.

2) Monopolistic supply of public extension service has been criticized since long by politicians and private sector alike. The capacity of the central level extension agencies has not been fully utilized in monitoring and support of district field activities. Departmental programme directorates as disciplinary specialized agencies should monitor extension programmes, help in regulatory oversight of input suppliers, conduct diagnostic studies, and facilitate linkage and coordination among service providers.

3) The traditional thinking of extension service as a state function has to change and mutually reinforcing roles of private and public services have to be emphasized. Private Service providers should not be seen as competitors by the public extension system but as partners. But total privatization is not feasible as government responsibility for targeted inclusive agricultural extension to small and marginal farmers, women, caste/ethnic communities, disadvantaged groups and areas should largely rest with the public service. Furthermore, pro-poor services, food security and Poverty alleviation should be the state responsibility.

4) Public extension is free but a reliable service is often not available to the masses. Experiences have shown that agricultural producers are willing to pay for commercial enterprises development services that increase their incomes (for example, agricultural and micro-irrigation technologies for market-oriented agricultural extension services experimented by IDE/Nepal). Hence, some element of fee-for-extension by producers or farmers' organizations should be implemented with embedded services.

5) An extension system suitable to meet the needs of farmers and farming communities in the twenty-first century should be conceived in the broader sense, than it has been in the past of merely being a provider of technical advice through lip service or word-of-mouth. It should coordinate and facilitate networking among public and private stakeholder institutions for research, education, inputs, credit, processing and marketing. Joint planning, implementation monitoring, impact assessment, and sharing in a project mode should be emphasized.

6) Rural youth migration for foreign employment is happening at a pace jeopardizing agricultural development. This work force should be attracted for gainful employment in agriculture and rural development through appropriate policies and programmes to modernize the agriculture sector.

7) The present extension service has reached more accessible areas and resource-rich farmers. The extension system should design appropriate mechanisms to cater to the needs and demands of resource-poor farmers, remote area farmers, different ethnic groups and *Dalits*.

8) Extension service is primarily focused on increasing agricultural productivity, and marketing and profitability analysis of innovations, crucial for agricultural commercialization, are weak. Capacity of research, education and training, and extension should be enhanced pursuant to goals of agricultural development. For this, agricultural human resources development, both in private and public sector, should be urgently addressed.

9) Production inputs, agricultural credit and marketing are binding constraints for agricultural development. Input suppliers are relatively more accessible in the Terai; hills and remote areas have paucity of input dealers. Where present, they complement extension with technical advices. The private input suppliers should be linked with research organisation (like Agricultural Research Centre) and local extension agencies (like DADO and DLSO) to support effective extension services delivery.

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## 9 Annexes

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Number of Nepal Standards related with food, food processing, transport and storage. Source: Department of Food Technology and Quality Control (2009)

<b>Food groups</b>	<b>No. of standards</b>
Milk and milk products	18
Fats and oils	16
Fruit and vegetable products	17
Spices and condiments	22
Tea, coffee, cocoa and their products	3
Salt	2
Cereals, pulses, and their products	23
Processed drinking water	2

Sweetening agent	3
Sweets and confectionary	3
<b>Total</b>	<b>109</b>