Nestlé

Good Food, Good Life

Nestlé in Society

Responsible Sourcing
Creating Shared Value

Sustainability of Dairy Farms
Islamic Republic of Iran

Enhancing Qualify of Life, and Contributing to a Healthier Future

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SUSTAINABILITY OF DAIRY FARMS IN QAZVIN PROVINCE, IRAN

A RISE analysis commissioned by Nestlé Iran

Christian Thalmann, Ph.D. sc.nat.

17.07.2015

BFH Bern University of Applied Sciences
HAFL School of Agricultural, Forest and Food Sciences
RISE (Response-Inducing Sustainability Evaluations)

2014 Performance Summary - Nestlé Middle East

Globally, Nestlé has developed performance indicators to provide a focus for measuring and reporting Creating Shared Value, sustainability and compliance. The reporting framework forms part of our communication on progress regarding the United Nations Global Compact Principles at a global level. This performance summary highlights key indicators for Nestlé in the Middle East for the year ending on 31 December 2014.
Read about our global performance indicators: www.nestle.com/csv/kpis

Nestlé In Society and Creating Shared Value key performance indicator	2013	2014
Economic		
Total Company sales (USD million) (a)	2,300	2,400
Nutrition		
Products meeting or exceeding Nestlé Nutritional Foundation profiling criteria (as % of total sales) (b)	86%	90%
Products analysed and improved or confirmed via 60/40+ programme (sales USD million) (c)	1,000	1,200
Number of servings of micro-nutrients fortified food products sold (billion servings) (d)	8.2	8.0
Products featuring Nestlé Nutritional Compass labelling (% of sales in Middle East) (e)	98%	99%
Products in the Middle East with Guideline Daily Amounts (GDA) labelling on front of pack (% of sales in Middle East) (f)	83%	91%
Products with specific portion guidance (sales, USD million)	600	640
Rural Development and Responsible Sourcing		
Percentage of suppliers that fully comply with the Nestlé Supplier Code	Not measured	92%
Water		
Total Water Withdrawal (m^3)	243,611	226,957
Total Water Withdrawal (m^3 per tonne of product)	2.12	2.02
Environmental Sustainability		
Production Volume (tonnes)	114,911	112,355
Materials		
Raw materials used (tonnes)	105,563	114,302
Materials for packaging purposes (tonnes)	25,857	23,625
Packaging source optimisation (tonnes saved)	60	462
Energy		
Total on-site energy consumption (gigajoules)	281,532	264,034
Total on-site energy consumption (gigajoules per tonne of product)	2.45	2.35
Emissions, effluents and waste		
Direct Greenhouse Gas (GHG) emissions (tonnes CO_2eq)	29,877	28,763
Direct GHG emissions (kg CO_2eq per tonne of product)	260	256
Total water discharge (m^3)	133,237	113,444
Total water discharge (m^3 per tonne of product)	1.16	1.01
Average quality of water discharged (mg COD/l)	30	28
Waste for disposal (tonne)	674	567
Environmental sustainability governance		
Manufacturing sites certified against ISO 14001 (% of total manufacturing sites)	100%	100%

(a) Includes all businesses of Nestlé for all thirteen countries in the Middle East (Dairy, Coffee, Culinary, Confectionary, Nutrition (including Wyeth Nutrition), Nestlé Professional, Breakfast Cereals, Health Science, Petcare, Waters, Nespresso)

(b) Covers Culinary, Coffee, Confectionary and Dairy categories. We evaluate our products against the Nestlé Nutritional Foundation criteria, which are based on scientific and public health recommendations (WHO, Institute of Medicine (IOM) and others).

(c) In the 60/40+ programme products are tested with consumer panels and at least 60 of the 100 people must prefer the Nestlé product over the competitor's. This KPI reflects the dynamic nature of our 60/40+ programme. Assessment results are valid for a maximum of three years, only if all parameters remain equal.

(d) Main product category contributors are: Dairy, Nutrition, Culinary, and Breakfast Cereals. Excludes Health Science, Infant Formula, and Nestlé Professional.

(e) The Nestlé Nutritional Compass has been launched since 2005 and provides nutrition information on the label through the nutrition table, in addition to tips for responsible usage and consumption.

(f) Excludes plain coffee, tea and water, products for Nestlé Professional, gifting chocolate, seasonings, Petcare, Health Science and Nutrition. Includes figures for both adult and child specific GDA-based labelling.

Highlights 2015 - 2016

1,732

Recruited under the age of 30 since 2010

4400

Impacted youth in 2016

50

Events across 10 countries in 2016

-63%

DECREASE IN ABSOLUTE WASTE

74%

INCREASE IN PRODUCTION VOLUME

-37%

DECREASE IN ENERGY* CONSUMPTION

8bn

MICRO-NUTRIENT FORTIFICATION
SERVINGS OF FORTIFIED PRODUCTS SOLD

-30%

SUGAR
IN CHILDREN BREAKFAST CEREALS

-10%

SALT
IN SELECTED CULINARY PRODUCTS

* Computed per tonne of product manufactured at our food factories.

Testimonials

Giuseppe Carella - Nestlé Iran Country Manager

"At Nestlé, our fundamental belief is that for our Company to remain successful over the last 150 years and beyond, to continue creating value for our shareholders, and to pursue our vision to enhance quality of life and to contribute to a healthier future, we must Create Shared Value for and with the Society. Project RISE is confirmation of how Nestlé is devoted to its 21 CSV Commitments to the Islamic Republic of Iran."

David Anderson - NME Technical Director

"Project RISE from Nestlé Iran is a model example of how we at Nestlé care deeply about sustainable local farming and rural development. We will continue to actively manage our commitments to environmental and social sustainability, which are necessary to operate our factories, and to the progressive development of the communities where we operate."

Faisal Haroon - Factory Manager, Nestlé Iran

"Rural Development is one of the key focus areas for Nestlé's 21 CSV commitments to the Islamic Republic of Iran and we are proud to work with the Governor of Qazvin, the Agriculture & Veterinary Organizations, the local milk farmers, and the University of Bern in Switzerland to increase the quality of locally sourced raw materials available to everybody in the Islamic Republic of Iran."

Alireza Sarabchi - Head of Communications and Marketing Services

"Project RISE is a testimonial to how great companies like Nestlé Iran can work hand in hand with numerous local and state authorities to create shared values in the Islamic Republic of Iran. It shows that when there is a common goal to create a healthier future for all, any and all obstacles can be overcome and that everybody can join together to make this a reality. This is something that we at Nestlé aim to do in every society in which we operate, and something that we are proud to leave as a lasting and sustainable legacy."

Dr. Ghazal Nemati - Agricultural Service Specialist, Nestlé Iran

"Project RISE by Nestlé Iran provides a shining example of how economic and environmental sustainability in local dairy farming does not have to come at the detriment of quality of life for the livestock or the farmers involved. I'm proud to be part of a team that has shown that professional dairy farms can increase the quality of the raw materials they produce for Iran and stay economically profitable, while still ensuring that the animals live happy lives and that the farmers go home every day with a smile."

Mr. Rezai - Farm Owner

"We are proud to become a model mega-farm for Iran's dairy industry with the support from Nestlé Iran. The transfer of knowledge provided by the Nestlé Iran Agricultural Services Department has benefitted not only the livestock and farmers at our farm, but has been successfully shared and implemented with our own customers as well. This creates a long-term partnership which adds value at each and every step of the dairy supply chain in the Islamic Republic of Iran."

Mr. Daghighi - Farm Owner

"The benefits of Nestlé Iran's Project RISE to our dairy farm have been countless. Not only has the quality of the milk supplied by our livestock increased, therefore boosting the number of customers we can supply to, this has been done with full economic & lifestyle benefits across the entire value chain in mind."

Dr. Naghibi - Director General of Qazvin Province, Veterinary Directorate

"It is very exciting to work alongside such an inspirational team and to see tangible, effective, and sustainable positive changes being made to the way we conduct dairy farming in Iran. The RISE project and the work done by the Nestlé Iran Agriculture Services Department paves the way for a future with healthier animals and increased economic benefits across the entire dairy industry and its value chain."

Summary of our Commitments in the Islamic Republic of Iran

Living up to our mission to enhance quality of life, this year we are publishing for the first time our commitments to society in the Middle East; Commitments that are in line with the way we do business defined by our strategy of Creating Shared Value.

With a particular focus on nutrition, health and wellness, our commitments also cover water and environmental sustainability, and highlight other topics including responsible sourcing, people and compliance. They are ambitious, reflecting our determination to meeting our responsibilities and contribute to addressing local challenges.
Some of these commitments, particularly those pertaining to nutrition, will focus specifically on children in accordance with our ongoing journey to nurture healthier generations.
All of our commitments invite stakeholders and partners to hold us accountable to what we promise, and solicit their feedback so we can continuously improve our actions and performance.

Nutrition

1. Build knowledge leadership in children's nutrition
2. Further provide nutritionally sound products designed for children
3. Help reduce the risk of under-nutrition through micronutrient fortification
4. Reduce sodium (salt) in our products
5. Reduce sugars in our products
6. Reduce saturated fats and remove trans fats from our products
7. Deliver nutrition information, advice and portion guidance
8. Promote healthy hydration as part of a healthy lifestyle
9. Promote healthy diets and lifestyle
10. Ensure responsible marketing communication to children
11. Market breast-milk substitutes responsibly

Responsible Sourcing

12. Implement responsible sourcing in our supply chain
13. Promote local sourcing of high quality raw materials

Water

14. Work to achieve water efficiency and sustainability across our operations

Environmental Sustainability

15. Improve resource efficiency in our operations
16. Improve the environmental performance of our packaging
17. Provide climate change leadership

Our People & Compliance

18. Foster further opportunities of starting and developing careers for the youth in the Middle East
19. Enhance gender balance
20. Ensure that all Nestlé units have the necessary systems in place to deliver the same level of basic safety and health protection for all employees
21. Provide training and education for Nestlé employees on nutrition quotient (NQ), environmental sustainability and creating shared value

Our Commitments and the rise of RISE

We at Nestlé touch billions of lives worldwide; from the farmers we work with to the individuals and families who enjoy our products, the communities where we live and work, and the natural environment upon which we all depend. Their challenges are our challenges. Their success is success in which we all share.

As part of our commitments and our purpose to enhance quality of life and contribute to a healthier future, Nestlé Iran has commissioned project RISE (Response-Inducing Sustainability Evaluations) with the strong collaboration of Bern University of Applied Sciences, Agricultural Jahad Organization, and local milk farms. RISE makes solid contributions in meeting Nestlé Iran's commitment to each of five categories mentioned previously (Nutrition, Responsible Sourcing, Water, Environmental Sustainability and Our People & Compliance) and will provide support to address sustainable performance issues in the farms. Our RISE strategy focuses on many areas including Milk Quality, Animal Welfare, Water Use, Working Conditions, Economic Viability, Animal Husbandry, and Quality of Life amongst others. As a result, the RISE strategy explores seven specific categories, which fall under the three main pillars which look at what works best for our consumers, our communities, and our planet.

FOR OUR CONSUMERS

Enhanced Nutrition

- Benefits of dairy-based nutrition
- Research and development
- Micronutrient fortification

Assured Quality

- Transparency back to the farm
- Quality control, food safety

FOR OUR COMMUNITIES

Farming & Local Livelihoods

- Farmer support
- Community enhacement

Animal Welfare

- Healthy cows

FOR OUR PLANET

Water

- Reducing water usage in factories
- Sharing best practices with farmers

Air Quality & Climate

- Reducing emissions in factories
- Reducing emissions on farms

Waste & Natural Capital

- Reducing waste in factories
- Natural capital on farms
- Packaging design

Message from our Chairman - Nestlé S.A.

To read the global report: http://www.nestle.com/csv
Know more about the global commitments, check the interactive graphics:
http://www.nestle.com/csv/what-is-csv/commitments

Paul Bulcke, Chairman of the Board of Directors, Nestlé S.A.

Creating Shared Value is how we bring our company purpose to life, and our commitments show how we contribute to society.

Paul Bulcke visiting the Food Safety Institute in Beijing
Paul Bulcke (Chairman, Nestlé) visiting Beijing in March 2014, to open the Nestlé Food Safety Institute, which works with authorities to help provide the scientific foundation for food safety policies and standards.

The year 2016 has marked an important milestone for Nestlé globally, as we celebrated our company's 150th anniversary. Our company's journey began with Henri Nestlé's invention of Farine Lactée infant cereal and ever since, we have lived up to our purpose of enhancing quality of life and contributing to a healthier future.

Every day, Nestlé touches the lives of billions of people worldwide: from our employees to the farmers who grow our ingredients and the families who enjoy our products; to the communities where we live and work; as well as the natural environment upon which we all depend. Guided by our values rooted in respect, we work alongside partners to create shared value – contributing to society while ensuring the long-term success of our business.

To be placed as external quote within the write up: Creating Shared Value is how we bring our company purpose to life, and our commitments show how we contribute to society.

Our Creating Shared Value priorities are those areas of greatest intersection between Nestlé's business and society, and where we can create the most value and make an important difference. These include: nutrition, to enable healthier and happier lives for individuals and families, with a strong focus on infants and children; rural development, to help develop thriving and resilient communities, and support better livelihoods for those we live and work with; and water, a critical resource for the planet and the lynchpin of food security. Our commitments in the areas of water and environmental sustainability underline our determination to steward natural resources for future generations.

Underpinning all these efforts are our commitments to compliance, human rights and our people. We respect and promote human rights, fair employment and diversity. An issue of major concern globally is the high level of unemployment experienced by young people. In response, we continue to extend our Global Youth Initiative while encouraging the participation of other companies and partners.

Behind all of these efforts are our company values, which are rooted in respect – respect for ourselves, respect for others, respect for diversity of the world we live in and respect for the future. Our Corporate Business Principles and Code of Business Conduct clearly set out our responsibilities.

They demonstrate our fundamental belief in Creating Shared Value as our way of delivering a long-term positive impact for shareholders and society, through everything that we do as a company. Creating Shared Value is unique in that it is a business strategy that allows us to target activities where we can optimize the creation of value for our shareholders, as well as for society.

Paul Bulcke
Chairman

Message from our Chairman and CEO Nestlé Middle East FZE

Yves Manghardt, Chairman and CEO of Nestlé Middle East FZE

"Creating Shared Value (CSV) is Nestlé's fundamental way of doing business. It is built on a foundation of compliance with the highest standards, international and local laws, internal regulations, codes of ethics and our own corporate business principles that incorporate the 10 United Nations Global Compact (UNGC) principles reflecting fairness, honesty and respect for people and the environment."

150 years ago, our company started with Henri Nestlé, a scientist who developed "Farine Lactée", the first infant cereal with milk that saved the life of a malnourished child. And since then Nutrition is at the heart of our company.

Our heritage in the Middle East goes back over 80 years to 1934, during which we built a foundation of trust and credibility among the people of the region, living up to our purpose of enhancing quality of life and contributing to a healthier future.

Today, Nestlé Middle East operates 19 factories and provides direct employment to over 11,000 people as well as indirect employment to several thousand more across different countries.

Globally, Nestlé in Society reports have been issued since 2004 representing a significant step forward in our drive to communicate transparently with our stakeholders about our actions in all the areas where we engage in society.

In a world facing long-term economic, social and nutrition challenges, Nestlé believes that corporations have a role to play in contributing to solutions. Since 2012, we also started publishing forward-looking Creating Shared Value commitments and reporting on progress, holding accountability on our promises.

Nestlé Middle East has embarked on this journey 2 years ago, announcing our regional Creating Shared Value commitments in the areas of nutrition, rural development and responsible sourcing, water, environmental sustainability, people and compliance.

As the leading Nutrition, Health and Wellness Company, we have a unique opportunity to help address the diverse nutrition challenges facing people across the world and in our region; from over nutrition to under nutrition including micronutrient deficiencies. We have the capacity, and more importantly, the determination to play a positive role in contributing to the solution by embedding the right actions into our work.

We emphasize continuous nutrition improvement of our products, based on scientific research and according to international recommendations, as well as micronutrient fortification to address specific local deficiencies. Nestlé also delivers clear nutrition labeling through the Nestlé Nutritional Compass that includes nutrition advice on portion guidance to help consumers make informed choices. Since 2011, we are the first infant formula manufacturer to be included in the FTSE4Good Index, the sole independent

and transparent third-party assessing marketing practices of breast milk substitutes. This is part of our ongoing efforts to promote good nutrition in the first 1,000 days of life, support breastfeeding, and report publicly on our progress regarding the responsible marketing of breastmilk substitutes.

Part of our responsible sourcing commitment, the project 'RISE' aim is to help build sustainable dairy farms in Iran, with the aim to create local partnership to decrease environmental harm by controlling the consumption of energy and water, controlling waste, and efficiently managing the livestock.

Protecting water as a scarce resource is a clear priority for Nestlé Iran and Iranian Government. We aim to contribute to Water stewardship through our water efficiency projects and waste water treatment facilities in our own factory operations and in dairy farms we work with.

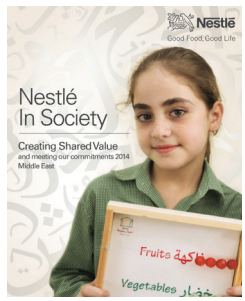
In addition, Nestlé Iran will continue engaging industries, institutes and authorities through workshops/conferences to contribute in driving water stewardship in Iran.

Overall, our actions in Creating Shared Value would not be the success they are, nor sustainable without the support and trust of the various institutions, governments, and other entities we work with in the region. We believe that concerted collective efforts can truly create a positive impact in society.

We are proud to celebrate 15 years of our operations in Iran, and look forward to many more years, living up to our purpose of enhancing quality of life and contributing to a healthier future.

Chairman and CEO of Nestlé Middle East, Yves Manghardt, visiting the Nestlé Dubai Manufacturing plant in TechnoPark, United Arab Emirates.

Yves Manghardt
Chairman and CEO
Nestlé Middle East FZE



Nestlé in Society - Creating Shared Value and meeting our commitments 2014 - Middle East
http://www.nestle-me.com/en/csv

Nestlé in Society - Creating Shared Value Progress and Commitments 2020 - Middle East
http://www.nestle-me.com/en/csv

Message from Nestlé Iran Country Manager

Giuseppe Carella, Nestlé Iran Country Manager

Globally we celebrated 150 years of our company last year, and in 2017, we celebrated 15 years of Nestlé Iran, built upon respect, resilience, and by living up to our purpose of enhancing quality of life and contributing to a healthier future.

In today's world, challenges of sustainable agricultural production are gaining the attention of farmers, consumers, industry, investors, and authorities. Today's consumers are not only demanding nutritional quality, availability and affordability, but are equally conscious about the impact of the whole value chain on the environment and the sustainability of raw material availability in sustained quality and quantities.

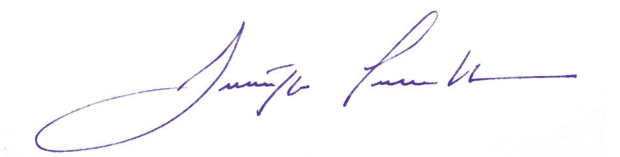
In Nestlé, as part of our Creating Shared Value global approach, we focus on nutrition to enable healthier and happier lives through offering tastier and healthier choices. In addition, Nestlé views rural development and sustainable sourcing as important areas of responsible local manufacturing to bring good nutrition for individuals and families.

In only our Iranian operations, we employ over 900 people, who are fully trained to produce highest quality products every day. Our local factories benefit from first-rate technology and work processes, fulfilling both local and Nestlé regulations. We are also continuously investing in state-of-the-art technologies to achieve high water efficiency and sustainability to minimize the impact of our operations on natural water resources. We believe it is impotant to share our know-how in these fields with the community to engage and empower everybody to contribute more.

"We at Nestlé know that we are very well positioned to Create Shared Value in and with the society in key areas by leveraging our specific know-how and our critical mass worldwide. Those areas are Nutrition, Water, and Rural Development, all of which come from the heart of our global and local commitments, and are specifically relevant to our purpose and our ability to enhance quality of life, and contribute to a healthier future in the Islamic Republic of Iran. This RISE project is a relevant example of how in Nestlé Iran we engage and deliver on our commitments to focus on Sustainability of Quality: quality of raw materials, quality of processes, and quality of life."

During last 5 years, we have reduced water consumption by 50% in our Qazvin operations. Our wastewater treatment plant is fully compliant and efficient to be considered as a successful model for other industries to follow.

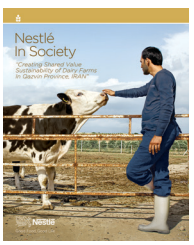
Nestlé also recognizes the challenges in the local dairy farms and has launched the RISE study in five professional milk farms of Qazvin Province in order to provide evidence based information on sustainable agricultural practices. This study provides recommendations to support milk farms to be economically, socially, and environmentally sustainable, while delivering high quality for the consumers. Nestlé Iran, together with the experts from Bern University of Applied Sciences, Switzerland, have conducted a scientific and evidence based assessment of Iranian milk farms and today we are proud to publish this Nestlé In Society report sharing our Creating Shared Value commitments in the country. It is only by working together that today, through close collaboration between Nestlé, Iranian farmers, local authorities, and the government, the RISE study has turned into a meaningful and sustainable reality, benefitting not only local farms, but all of Iranian society.



Giuseppe Carella
Country Manager
Nestlé Iran PJSCo

Giuseppe Carella, visiting dairy farms with executive board members of Nestlé S.A.

Winner Of I. R. Iran's National Award for Corporate Social Responsibility



Nestlé in Society Responsible Sourcing Creating Shared Value 2015

Nestlé in Society Responsible Sourcing Creating Shared Value 2017

Creating Shared Value at Nestlé

Creating Shared Value is the fundamental way Nestlé does business across the entire value chain, and the way we connect with society at large. It begins with the understanding that for our business to prosper over the long term, the communities we serve must also prosper. It entails businesses creating competitive advantage, which in turn will deliver better returns for shareholders, through actions that substantially address a social or environmental challenge. It is built on strong foundations of compliance and sustainable business practices to preserve the environment for future generations.

As a company, we are best positioned to create shared value in three areas: **nutrition, water and rural development.**

A key pillar in our Creating Shared Value strategy is nutrition because food and nutrition are the basis of health and of our business – it's the reason why we exist. Nestlé's mission is to enhance the quality of life of our consumers by providing tastier and healthier food and beverage choices, and services that help people improve their nutrition, health and wellness.

Our focus on water and rural development is driven by their critical importance not only to our business but also to our employees, farmers, suppliers, distributors and communities where we operate.

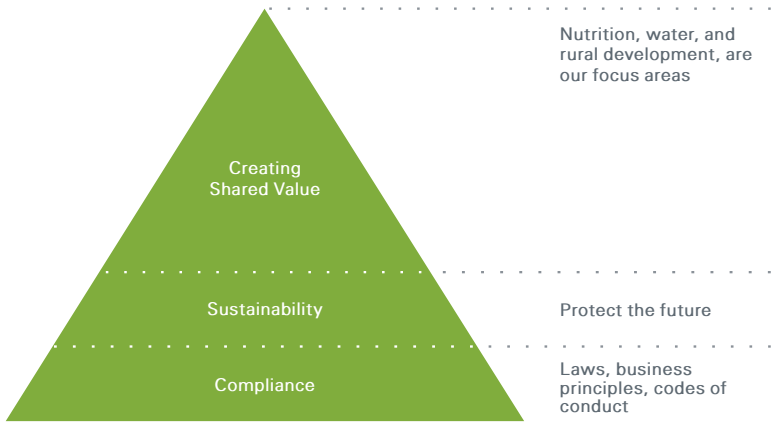
We live up to our commitments to environmental, social and economic sustainability through business practices embedded at the core of our operations. These aim to deliver better financial results for our shareholders by improving working conditions for our suppliers, instilling environmental practices that both benefit the planet and cut costs, and enhancing products to meet the specific needs of our customers.

This involves substantial training and education of people inside and outside of Nestlé, as well as large investments in technology with lower environmental impact. We are also one of the founding members of the UN Global Compact Lead – an important platform for corporate sustainability leadership.

Creating Shared Value requires compliance with the highest standards of business practice, including international codes and standards as well as our own Code of Business Conduct, Corporate Business Principles, and Management and Leadership Principles.

Read more about CSV on:
http://www.nestle.com/csv

Creating Shared Value



Our Corporate Business Principles: foundation of Creating Shared Value

It is essential that we build our business on clear principles and sound governance. The Nestlé Corporate Business Principles rule the way we do business and form the basis of our culture and values. The 10 principles, which provide the foundations for our commitments and our Creating Shared Value strategy, incorporate the 10 United Nation Global Compact (UNGC)* Principles are divided into five areas: consumers, human rights and labour practices, our people, suppliers and customers, and the environment.

Why are they important?

We believe that it's essential to have clear principles and values that are built upon respect for our consumers, our people, suppliers, customers and the environment, and a strong compliance culture that is fully embedded in our business. Demonstrating our adherence builds trust among our stakeholders, ensuring they have confidence in the Nestlé brand and what it stands for, both now and in the future.

How are they applied?

All our employees are required to comply with Nestlé's Corporate Business Principles and we continuously monitor their application and effectiveness. Our principles are implemented through relevant business codes, policies, processes and tools, which have been developed to ensure they are practiced every single day, across the Company. We set high standards, always following the Nestlé Corporate Business Principles wherever we operate – even if local laws are more lenient or non-existent.

The Nestlé Corporate Business Principles

The diagram below gives an overview of the 10 Nestlé Corporate Business Principles and what we want to achieve through them.

Consumers	1	Nutrition, health and wellness	We aim to enhance the quality of consumers' lives by offering tastier, healthier food and drinks and encouraging a healthy lifestyle.
	2	Quality assurance and product safety	We want to ensure that, everywhere in the world, the Nestlé name represents the highest levels of product safety and quality.
	3	Consumer communication	We are committed to responsible, reliable communication that informs consumers, promotes healthier diets and respects consumer privacy.
Human rights and labour practices	4	Human rights in our business activities	We fully support the UNGC's principles on human rights and labour, and aim to set an example of good human rights and labour practices throughout our business activities.
Our people	5	Leadership and personal responsibility	While fostering a culture of respect and dignity, we provide our people with equal opportunities for development, protect their privacy and do not tolerate any form of harassment or discrimination against them. At the same time, we expect our employees to be responsible, motivated, and to live up to our values.
	6	Safety and health at work	We are committed to preventing work-related accidents, injuries and illnesses, and to protecting employees, contractors and others involved along the value chain.
Suppliers and customers	7	Supplier and customer relations	We require our suppliers, agents, subcontractors and their employees to demonstrate honesty, integrity and fairness, and to adhere to our non-negotiable standards.
	8	Agriculture and rural development	We aim to help rural communities become more environmentally sustainable by contributing in a range of areas, including agricultural production and the social and economic status of farmers.
The environment	9	Environmental sustainability	We are committed to environmentally sustainable business practices and strive to use natural resources efficiently, achieve zero waste and use sustainably managed renewable resources.
	10	Water	The world faces a growing water challenge, and we are committed to using water sustainably and improving our water management.

The World's Leading Nutrition Health and Wellness Company

Nutrition has been the cornerstone of Nestlé since 1866 when Henri Nestlé developed his first infant cereal to save the life of his neighbour's child who was unable to breastfeed and suffering from malnutrition.

Henri Nestlé

Founded in Switzerland, Nestlé operates in almost 200 countries and employs close to 340,000 people all over the world.

Globally, Nestlé has the largest research and development (R&D) organisation of any food company, with about 6,000 people involved in R&D, as well as a number of research partnerships with businesses and universities. The Company has 39 R&D and Product Technology Centres around the world, which develop innovative technologies and manufacturing processes that form the basis of new product development, and are applied in operations. The R&D centres have both global and local roles, by meeting regional needs and providing technical expertise in specific areas.

For nearly 150 years, Nestlé has been committed to enhancing people's lives wherever they may live by offering the highest quality of tasty and healthy food and beverage choices at all stages of life and at all times of the day.

Nestlé in the Middle East

Our heritage in the Middle East goes back over 80 years to 1934 when the first import operation was set up in Lebanon. Building a foundation of trust among consumers has since made us the region's leading Nutrition, Health and Wellness Company. Today, Nestlé owns and operates 19 factories that cater to the region, and provides direct employment to more than 11,000 people, more than half of whom work for Nestlé Waters. Nestlé also provides indirect employment to several thousand more.

The Nestlé Middle East entity itself was formed in 1997, with headquarters in the United Arab Emirates, consolidating the Company's presence in the Gulf Cooperation Council (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates), Levant (Lebanon, Jordan, Palestine, and Syria), Iran, Iraq and Yemen – covering a population of over 220 million. With total investments in the region of US $400 million over the last five years, for Nestlé, the Middle East means growth, future potential, talent, and innovation. It also means a challenging business, considering security and political volatility in the region, which reflects directly on the wellbeing of its people.

One word that likely sums the region up for us is

Nestlé Headquarters in Vevey, Switzerland.

"diversity", because that is what the Middle East is about in every way; home to developed and emerging economies with affluent populations as well as many who have very little; a majority young population mixing with growing numbers of elderly; and completely different cultural demographics encompassing very strong traditional societies as well as very modern lifestyles. It's also a region of health issues where obesity and malnutrition coexist, sometimes within the same community.

Nestlé understands the health challenges of the region and ensures that our products cater to the latest nutrition recommendations for healthy living. Nestlé's mission is to enhance people's quality of life with good food and beverages everywhere. In the Middle East, we strive to do that by offering an array of tasty and healthy products that meet local needs for quality, safety, taste and pleasure – while addressing specific nutritional requirements to help achieve healthy and balanced diets across all life stages.

Nestlé in the Islamic Republic of Iran

Nestlé Iran was registered in 1995. After receiving the investment decree on 9th September 2001, Nestlé officially began its activity in the I.R.Iran. In May 2003, Nestlé Iran started manufacturing and sales of Nestlé CERELAC®. Year after year, Nestlé Iran tried to grow its business in I.R.Iran. In December 2004, Nestlé Iran imported and launched NESCAFÉ® and COFFEE-MATE® and less than a year later in September 2005, the company imported and launched MAGGI® Bouillon, Soups, Mixes.

In 2007, Nestlé Iran achieved another milestone: production of NAN® with the most advanced technology and based on the latest formulation. Local manufacturing of infant formula helped to supply the major need of the market. Nestlé Iran succeeded to export its well-known international brands; NAN and CERELAC out of it's Qazvin factory to the Persian Gulf countries.

In the same year Nestlé Iran took another step to promote its business in the country: Importation of Nestlé Breakfast Cereals FITNESS®, CORN FLAKES, NESQUIK®, and CHOCAPIC®.

In 2007 Nestlé invested in the bottled water industry and started the production of Nestlé Pure Life® in Iran. During 2009-2010 Nestlé started manufacturing and exporting NAN 3 and GUIGOZ® Infant Formula and increased its export activities.

In 2015, Nestlé invested in a new factory to produce NESQUIK® (chocolate powder) and NESCAFÉ® (3 in1).

In 2016, Nestlé made a new investment to source high quality milk from local suppliers, this includes the fresh milk reception site and RISE study.

Nestlé Iran has continued its development despite many local and international challenges and looks forward to further growth in the Islamic Republic of Iran. Nestlé is proud to contribute positively to the economic development of the country by investing more than US $100 millions its 3 factories and providing direct job opportunities for over 800 people.

Nestlé Iran Factory, Qazvin

Creating Shared Value - Nestlé Middle East - 2016

US $2.4 Billion
Total sales in the Middle East

24%
Women among total managerial positions

13,000
Employees across the region

Creating Shared Value

18
Factories across the region

US $620 Million
Investments in the region since 2010

US $340 Million
Salaries and social welfare expenses

Nestlé Manufacturing in the Middle East

Food Factories

Nestlé Dubai Manufacturing in Techno Park
Milk Powder, Chocolate and Culinary

Nestlé Iran Manufacturing in Qazvin
Infant Cereals, Infant Formula, Powdered Beverages and Coffee Mixes

Al Maha Factory in Dubai South
Culinary, Coffee Mixes

Water factories

Our Purpose

Enhancing quality of life
and contributing to a healthier future

Nutrition

Responsible Sourcing

Our People & Compliance

Water

Environmental Sustainability

Facts about Nestlé Iran

1995

Nestlé was registered in Iran

2001

Received investment decree on 9th of September

2003

Started manufacturing and sales of NESTLÉ CERELAC®.

2004

Started the import of NESCAFÉ® & NESTLÉ COFFEE-MATE®.

2005

- Started the import of MAGGI®
- Started the import of PETCARE®

2007

- Started production of NESTLÉ NAN® in Qazvin.
- Started the export of NESTLÉ NAN® and NESTLÉ CERELAC® from Qazvin factory.
- Started the import of Nestlé Breakfast Cereals; NESTLÉ FITNESS®, NESTLÉ CORN FLAKES®, NESTLÉ CHOCAPIC® and LION®.
- Nestlé Waters S.A France invested in the bottled water and started the production of NESTLÉ PURE LIFE®.

2008

GOURMET Gold

Nestlé PROFESSIONAL

Started NESTLÉ PROFESSIONAL, the out of home business.

۱۵ قدم با عشق...

۱۵ سال

Nestlé

Good Food, Good Life

در جمهوری اسلامی ایران

2010

Started the export of NESTLÉ NAN3® infant formula.

2012

Started the import of NESTLÉ HEALTH SCIENCE®.

2014

Started Project RISE, which aims at sourcing of milk from local suppliers, and invested in a fresh milk reception site in Nestlé Iran factory in Qazvin province.

2015

- Nestlé invested in a factory to produce NESQUIK® chocolate powder and NESCAFÉ® (3 in1).
- Nominated as top exporter of Qazvin province.

2016

- Nominated as top exporter of Qazvin province.
- Inauguration of Qazvin fresh milk reception facility in Nestlé Iran factory in Qazvin province.
- Fresh milk local sourcing for Nestlé Iran factory.
- Launch of YOUth initiative with Tehran University, management faculty.
- Started the import of PERRIER® sparkling mineral water.

2017

- Started the export of NESTLÉ GUIGOZ®.
- Started the NUTRIBITES project.
- Started Nestlé Sales Academy program.
- Started the production and sales of Nestlé NANKID®.
- Winner of I.R. Iran's national award for corporate social responsibility.
- Celebrating 15 Years of presence in the country.
- Started the Manure Management project in dairy farms.
- Started the Project Invade

2018

- Inauguration of Project Going Beyond Zero

SUSTAINABILITY OF DAIRY FARMS IN QAZVIN PROVINCE, IRAN

A RISE analysis commissioned by Nestlé Iran
Christian Thalmann, Ph.D. sc.nat.

BFH Bern University of Applied Sciences
HAFL School of Agricultural, Forest and Food Sciences
RISE (Response-Inducing Sustainability Evaluations)

List of Abbreviation	
CA	Conservation agriculture
DS	Degree of sustainability
GJ	Giga joule
ha	Hectare
HAFL	School of Agricultural, Forest and Food Sciences (Bern University of Applied Sciences)
H	Holstein breed
LLU	Large livestock unit
PPP	Plant protection product
RISE	Response-Inducing Sustainability Evaluation
SOM	Soil Organic Matter

1. Summary

Sustainability study of Iranian dairy farms

For this study, five farms in the wide vicinity of Qazvin were visited in June 2015. The farm managers were interviewed using the RISE-method (Response-Inducing Sustainability Evaluation). Before the farm assessments were conducted, the project was discussed with local experts to get a deeper understanding of the local conditions in the agricultural sector. Regarding the RISE model, regional data was collected beforehand to adapt the model to the local conditions. This integrated sustainability assessment approach, allowed an environmental, social and economic assessment of the dairy farms in the Qazvin region.

The overall objective of the RISE sustainability analysis was to identify opportunities for improving the sustainability performance of the studied dairy farms. Based on the farm visits, discussions with the farmers and local experts as well as the RISE sustainability analysis, recommendations are given for a targeted approach to increase the sustainability of the dairy farms in the target region.

The sample of farms analysed had the structural particularity that the farms were large (up to 760 ha and between 353 and 2,345 livestock units). Furthermore, our focus was on assessing farms specialised in dairy production.

The studied farms reached high yields both in animal (up to 13,800 kg milk) and in crop production (those practicing crop production). The breed was Holstein requiring high level of quality in animal husbandry, including high-quality feedstuff, medical care and medication. The farms mostly met these requirements. However, some weaknesses were also identified regarding animal husbandry. Hence, there is need for continuous investment in infrastructure and constant effort of staff at all levels to keep the current level of productivity, while improving the animal welfare.

The most critical issue for long-term sustainability of the studied farms was the intensive use of the resources water and energy. Combined with an inefficient use of nutrients due to the largely decoupled animal and crop production systems.

While three farms produced own fodder to some extent, the others entirely depended on constant supply of high quantities of high quality feedstuff. Farms were vulnerable in this respect, and their management needed to explore ways to cope with this risk.

Success in crop production depended to a great extent on availability of water for irrigation and on sufficient supply of nutrients. Partly old irrigation techniques and suboptimal irrigation practices offer opportunities for improvement in this domain. However, dropping ground water tables at alarming speed made clear that the water issue has to be tackled. The water issue also needed support at regulatory and controlling levels, for which, effective actions from the Authorities would be required. Beside water, high and inefficient use of energy was identified at the farms. Therefore, farms were dependent on low energy prices. Concerning nutrient supply, farms covered their needs either with mineral fertilizers or with dried manure. On some farms, this was not sufficient to replace removed nutrients. Latest at medium-term declining yields are expected for them. On the other hand farms would all have great potential to use manure more efficiently. So far, farms only use the smallest part of their manure for fertilization.

According to available data in the economic dimension, the farms were confronted to liquidity problems, imposing a particular challenge for the farm management. All farms analysed were able to produce positive cash flow, but the profitability largely depended on the level of indebtedness. Some of the farms should avoid to overload the dependency on external financings. For older farms, it was a challenge to keep infrastructure in good condition in order to meet high requirements of the intensive production system.

The analysed farms were important employer for the communities with a constant value creation in the region. For the workers it is important to have a job. Their working conditions were characterized by long working hours (12h/d) and sometimes with lack of days-off during the whole year. Furthermore there was a general low level of salaries particularly of the lower employment levels.

The management of the intensive animal husbandry systems is challenging, and there are plans for expansion on some farms. However, with more support from extension services, locally adapted innovations could be supported, with the aim to keep the well-developed production levels, and to advance the overall sustainability performance of the farms.

Summary of recommendations

The recommendations are grouped into high priority recommendations and medium priority recommendations. Please refer to the detailed text below, for further information.

High priority

- Reduce water consumption:
  - Plant crops requiring less water like sorghum, and clover.
  - Use non-turning soil cultivation techniques like subsoilers (instead of ploughing) and other soil and water conserving methods.
  - Use improved irrigation systems like Low Energy Precision Application (LEPA) or subsurface drip irrigation systems (SDI)[1,2].
- Reduce energy consumption:
  - There is high potential for reducing energy consumption by installing energy efficient devices in heating, cooling and pumping.
- Replace fossil energy with renewable energy:
  - Due to high solar irradiation in the region, there is a great potential to achieve high yields in photovoltaic plants and solar thermal collectors.
  - There are large amounts of slurry, which would be suitable for the production of methane in biogas digesters.
  - Improve manure management. One goal is to reduce emissions to the environment and the other is to link animal husbandry and crop & fodder production together. Further, more efficient ways to use manure in crop production should be explored.
  - Farms not practicing crop production should explore whether they could start with crop production or, at least, to find crop producing farmers who would cooperate in manure management.
  - It is recommended to apply fresh manure and slurry on the available fields, with appropriate techniques (to avoid environmental pollution). As the application of slurry is not common in the region, so far, a pilot project could be initiated together with Administration and Iranian Universities, in order to explore the effects and practicability in the Iranian context.

Medium priority

- Personnel management: Improve personnel management and worker skills with trainings. Explore new ways to

1. Lamm F. Advantages and disadvantages of subsurface drip irrigation. Kansas State University http://ucanr.edu/sites/adi/files/204430.pdf
2. Payero J., Yonts C., Irmak S., Terkalson D.. Advantages and disadvantages of subsurface drip irrigation. University of Nebraska. http://www.ianrpubs.unl.edu/live/ec776/build/ec776.pdf

improve worker motivation. If financially possible the salaries should be increased.
- Improve the animal welfare and animal health situation. Issues were very much farm-specific. This includes management practices and deficient installations.
- Encourage the planting of trees and shrubs to stabilize the agroecosystems, to provide shade and fodder for the animals, and to cool down the hot micro-climate.

2. Introduction

2.1 Objectives of this study

Trainings could be held by local agricultural extension officers, freelance advisors, companies (e.g. for devices for energy saving, or biogas production) and with the involvement of universities and the Authorities. Topics of interest for such workshops could be: improved irrigation practices, energy saving technologies, improved manure management systems, fertilization planning, efficient application of manure, application of slurry, improved waste management (e.g. proper disposal of cadavers), personnel management (e.g. introduction of worker friendly incentive systems).
Furthermore, training programs are needed to improve skills and knowledge of farm workers in the domain of animal husbandry (e.g. about alternative breeds, animal health, heat observation of cattle).

2.2 Sustainable development and sustainable agriculture

The present study was commissioned to evaluate the sustainability of dairy farms in Qazvin region. The Response-Inducing Sustainability Evaluation (RISE), a method developed at the School of Agricultural, Forest and Food Sciences (HAFL), a department of the Bern University of Applied Sciences, was applied to assess the environmental, social and economic sustainability of the dairy farms.
The overall objective of the RISE sustainability analysis was to identify opportunities for improving the sustainability performance of the studied farms. Based on the farm visits, discussions with the farmers and the RISE sustainability analysis, recommendations are given for a targeted approach to increase the sustainability of the dairy farms in the target region.

The vision of a sustainable development that satisfies human needs in a fair manner, while maintaining the integrity of natural ecosystems, politically emanates from the 1987 report "Our common future" of the World Commission on Environment and Development (WCED, 1987). It was globally legitimated through the 1992 United Nations Conference on Environment and Development in Rio de Janeiro and a continuing follow-up process. One of the 1992 summit's major outcomes, Agenda 21, includes a whole chapter (Chapter 14) on sustainable agriculture and rural development.
Sustainable development in the agricultural sector is "characterized by an appropriate balance between food self-sufficiency and food self-reliance, employment and income generation in rural areas, and natural resource conservation and environment protection" (FAO Council, 1989). Such development will likely not be realized through a single technology or type of production, but can be realized through different pathways, adapted to the respective local circumstances (FAO-NRDD, 2012). At the level of a single farm or company, sustainability translates into managing the enterprise with a long-term and multi-dimensional view on the use of natural, human and financial resources. In processing companies who depend on a steady supply with high-quality raw materials, reliable knowledge on the sustainability of suppliers is becoming an ever more important success factor.
The practical application of the sustainability paradigm in strategy development and everyday management is a major challenge, as balances must be maintained between short-term profits and long-term economic resilience, and between a holistic view of the company or farm and the identification of priority areas where immediate action is needed.

3. Methodology

3.1 The RISE method

The Response-Inducing Sustainability Evaluation (RISE) is a method for assessing the environmental, social and economic sustainability of agricultural production at farm level. It has been developed at the School of Agricultural, Forest and Food Sciences (HAFL) a department of Bern University of Applied Sciences in Switzerland. RISE has been applied on more than 2200 farms since the year 2000 in various production systems around the world.
Principally, the goals of a RISE assessment are:

- To enable a discussion about sustainable farming based on an objective analysis,
- To initiate reflection through awareness rising and
- To induce an intrinsically motivated process of continuous improvement of the sustainability performance.

RISE results may also allow farmers to monitor their own performance over several years, to design scenarios in a process of strategic planning, to compare results with colleagues and to discuss common issues in farmer groups.
A RISE analysis usually starts with the collection of information on the ecological, economic and social aspects through a questionnaire-based interview with the farmer. The most precise and reliable sources of data available are used. Where available, the documentation of the past farm-year is used, otherwise the best estimate is taken. No measurements are conducted. The interview always includes a walk-around on the farm site.
Data is stored in a central database. A computer program then uses these data to calculate 50 sustainability parameters, condensed into ten indicators. Results are presented to and thoroughly discussed with farmers. The RISE approach is meant to address the intrinsic motivation of farmers by placing the long-term consequences of farmer's actions, even across generations, in the centre of discussion.
The last part of the RISE process focuses on the implementation of concrete measures for improving sustainability at the farm level. The concrete procedure of this follow-up process depends on the particular project framework. The best results were achieved when the analysis was an integrated part of a process, structure or project promoting the implementation of sustainable and practicable solutions (Thalmann & Grenz, 2012)[1].

1. Thalmann C., and Grenz J. (2013) Factors Affecting the Implementation of Measures for Improving Sustainability on Farms Following the RISE Sustainability Evaluation Marta-Costa E., Ana Alexandra and Soares da Silva, Emiliana L. D. G. (eds.) Methods and Procedures for Building Sustainable Farming Systems. Springer Netherlands, p. 107-121.

Calculation of parameters and indicators

The RISE indicator framework follows the following logic:

- Raw data level: Basic information (e.g. distance to rivers, details on agrochemicals application).
- Parameter level: Information on a specific subject of a theme (e.g. particular risks to water quality).
- Indicator level: Overview of a specific theme (e.g. water use). The 10 indicators are described by 50 parameters.
- Sustainability polygon: Global picture of the farm's sustainability indicators.

The farm **raw data** entered to the computer program during the interview are combined with reference data and transformed into a scale from 0 to 100, using one or several valuation functions resulting in parameter values. The scores reflect no pass-or-fail classification, but position the farm's performance on a continuum ranging from 0 points (intolerable) to 100 points (fully in line with the sustainability goal of the parameter).
All valuated data are visualized using a "traffic light" colour code: red indicates problems (inacceptable), yellow means that further scrutiny is recommended (critical), and green (optimal) indicates practices that can most likely be continued without major sustainability risks (Fig.1).

Fig. 1. Scores and colour code used in the RISE method.

The indicator scores, termed as "degrees of sustainability", are the arithmetic means of four to seven equally weighted parameters.
Indicator scores are not further aggregated into a single "sustainability index" to prevent a masking of relevant information. Thus, a very high score of one indicator, e.g. economic viability, cannot outbalance a problematic situation of another, e.g. nutrient flows.
The most aggregated form of the RISE 2.0 results is the sustainability polygon in which the degrees of sustainability of all indicators are shown at a glance (Fig. 2). An optimal result would be one where all indicator scores are in the green area and no parameter scores in the red area.
A detailed description of the method can be found in Grenz et al. (2011)[2].

2. Grenz J., Thalmann C., Stämpfli A., Studer C., Häni F. (2009) RISE – a method for assessing the sustainability of agricultural production at farm level. Rural Development News (1) 2009, 5-9.

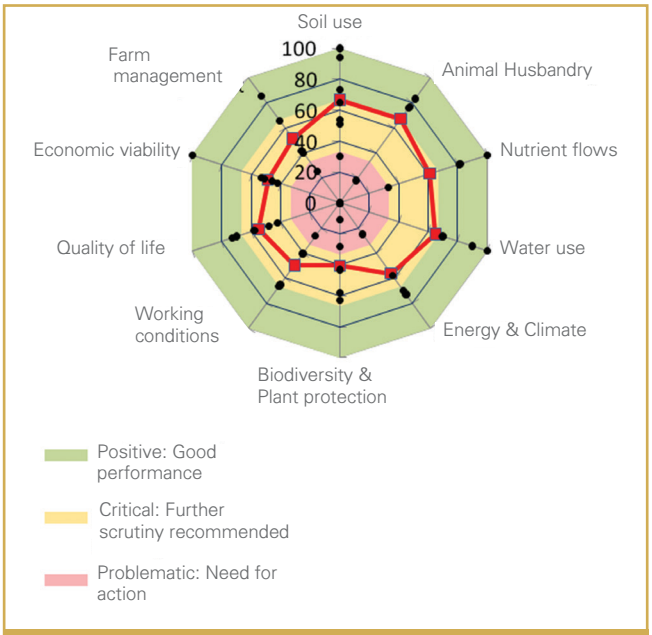


Fig. 2. The RISE 2.0 sustainability polygon.

3.2 Study design and process

The RISE evaluation took place from June 6th to 11th 2015 in Qazvin province. The evaluation process was divided into the interview part and the feedback discussion.
During the field visit, regional data such as climate, yield level, minimal income and other data were collected and entered to the RISE database. During and after the field visit these data were discussed with the participants.
For this study, five farms in the wider vicinity (50km) of the Nestlé factory in Zibashahr, near Qazvin, were selected and contacted in advance by the Nestlé staff. There was no business relation between the farms and Nestlé, so far. The participation in the RISE process was voluntary for farmers and they were compensated for their temporal expenditure. For confidentiality reasons, neither the names nor the exact locations of the farms are disclosed in this report.
After data analysis and interpretation of the results the farmers were visited again or came to the Nestlé factory. In these feedback discussions, individual results were explained, strengths and weaknesses discussed and opportunities for improving the sustainability performance were identified. The RISE field manual (Grenz et al., 2011), as well as further sources of information (cited), were used for data interpretation.
On-farm data collection and feedback discussions were accomplished by Dr. Christian Thalmann of HAFL, together with Mr Alireza Mansouri Hamlabadi (Local Sourcing Coordinator, Nestlé Iran), Dr Ghazal Nemati (agricultural service specialist, Nestlé Iran), Dr Pejman Atrian (agricultural service specialist, Nestlé Iran), Mr Faramarz Bahrami (QA Field Supervisor, Nestlé Iran), Dr Raval Aghdami (Head Of Hygiene Supervision of Veterinary Administration), and Mr Ali Azad Imani (Agronomist in Qazvin Agriculture Ministry). For the participants in the interviews and feedback discussions, the evaluations served as a first hands-on experience in applying the RISE method. HAFL staff supported the process with scientific and technical backstopping and the interpretation of results in the present report.

3.3 System boundary

Temporal system boundary: The RISE analysis considers the activities in 2014. Data on acreage, yields, cultivation methods (e.g. pesticide use), use of resources, employment, salaries and finances refer to that year. Only some information such as soil degradation, deforestation and reforestation refer to the last 5 to 20 years.
Spatial and financial system boundary: There is consistency with the spatial and financial system boundaries. All of the five farms were organized as a holding. Depending on the willingness of the farmers to share the financial data; the various financial parameters could be calculated. For the analysis of the level of wages, consistency is made with the income sources considered and the required working time to achieve these incomes. At a regional level, data were summarized to identify tendencies within the observed farms and to draw more general conclusions, where possible.

3.4 Farm profiles

Tab. 1. Key figures of the five dairy farms analyzed in Qazvin region in 2015. All figures refer to the year 2014.

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg farms 1, 3, 5
Farm type	Crops / dairy	Dairy	Crops / dairy	Dairy	Crops / dairy	
Agri. areas / Yields	**50ha**	**0ha**	**760ha**	**0ha**	**200ha**	**212ha**
Alfalfa (30t/ha)[1]	5ha (20t/ha)		170ha (15t/ha)		53ha (25t/ha)	46ha
Corn for silage (11t/ha)	45ha (45t/ha)		170ha (15t/ha)		36ha (60t/ha)	50ha
Winter wheat (6t/ha)	45ha (6t/ha)		120ha (6.5t/ha)		45ha (7.5t/ha)	42ha
Sugar beets (60t/ha)			10ha (95t/ha)			
Rape seed (3.5t/ha)			40ha (3.7t/ha)			8ha
Winter barley (7t/ha)			120ha (8.5t/ha)		20ha (8t/ha)	28ha
Fruit orchard (15t/ha)					23ha (50t/ha)	5ha
Fallow			150ha			40ha
Livestock (LLU[2])	**353**	**2,345**	**1,575**	**1,586**	**606**	**479**
Dairy cows	260	1,829	1,200	1,200	500	997
Heifers 1-2 years	125	543	500	500	160	365
Heifers < 1 year old	165	1,195	700	745	170	595
Milk yield (kg per cow)	11,000	11,000	10,500	10,000	13,800	11,260
Milk yield (kg per herd)	2,860,000	20,119,000	12,600,000	12,000,000	6,900,000	10,895,800
Number of working persons	15	136	97	57	49	71
Number of working hours	38,280	396,032	248,352	142,272	133,068	191,600
Operational cash flow (IRR[3])	19,928,217,600	[4]	18,633,992,192	19,05,599,744	-56,933,642,240	

4. Results and discussion

As an introduction to this chapter, some important comments on the interpretation and use of RISE results are summarized. Further explanations can be found in the RISE manual (Grenz et al., 2011). Especially for the farmer feedback, it is important to not only "dig for problems", but to duly consider and mention parameters with a good performance as well. Results have to be well explained by a person with agronomic and local knowledge and should be brought together with the farmers' interests and perspectives. To create an atmosphere of trust and respect, enough time should be given for the farmers to express their point of view. Hence, the best way to start the feedback discussion is to ask the farmer how he/she would estimate the sustainability performance of their farm.

For over-regional comparison it has to be taken into account that several ecological, social and economic benchmarks are adaptable to regional conditions. Please note that we do not recommend to further aggregate indicator values and/or to use RISE for certification or any kind of pass-or-fail tests.

1. Standard yield for the region
2. Large livestock units
3. US$ /IRR = 25,904.5 (mean exchange rate for 2014)
4. Cash flow before interests (Farm income - farm expenses) IRR 189'752'999'936

4.1 Sustainability polygon and aggregated results

The interpretation of results starts with the RISE polygon, which gives an overview of the sustainability performance of a single farm or of the average of a group of farms (Fig.3).

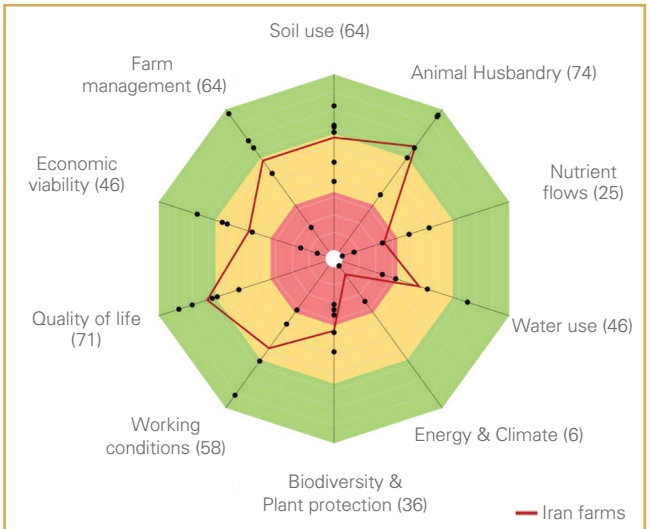


Fig. 3. Average sustainability polygon of the RISE analysis in dairy farms, Qazvin province, 2015. The red solid line represents the average indicator values of the five farms analysed. The line connects the degrees of sustainability of the indicator. Black dots represent average parameter values. Indicators and parameters located in the red zone indicate problematic situations, in the green zone a good performance, and the yellow zone represents the 'threshold area' between the two.

The red line connects the scores of the ten indicators on a scale from 0 (worst) to 100 (best). The parameter values, which are presented in tabular form for every indicator (further below), are the entry points to a more specific, measure-oriented discussion.

The ideal farm according to the RISE model would have the red line building a balanced polygon in the green (positive) area, with no parameter scores in the red and yellow (critical resp. negative) areas. This means that economical dimension is not maximised at the expense of the environmental or social dimension. Due to trade-offs between e.g. animal production and ammonia emissions, or crop productivity and biodiversity promotion, achieving 100 points for every single parameter on one farm is not possible.

The summary sustainability polygon of the five dairy farms in Qazvin province was characterized by six of ten indicator scores being in the mid-range (yellow) of the RISE sustainability scale. Results for *Animal husbandry* and *Quality of life* indicated a good performance, while the scores for *Energy & Climate* and *Nutrient flows* were in the problematic range.

The variability of results at indicator level was particularly high for *Economic viability*, whereas it was low for *Energy & Climate*, *Quality of life,* and *Farm management.* All other indicators were in between (Tab. 2). At parameter level, large standard deviations of more than 20 RISE points occur in 14 of the 50 parameters (detail results in next chapter). This observation underlines the importance of evaluating RISE results in detail. Indicator scores are arithmetic averages of parameter scores and can thus appear more homogenous due to an outbalancing of scores. The most problematic result is that for *Energy & Climate*, as all five farms score very low on this indicator. The results for *Animal husbandry* and *Quality of* life are the best, with four of five farms scoring high. See Fig. 4 for the individual farm polygons.

Tab. 2. Average indicator values of the five farms analysed with RISE in Qazvin province, 2015. Color code at Standard deviation stands for red = high SD; blue = small SD

Theme	Unit	Average score	Standard deviation	Highest score	Lowest score
Soil use	Points	64	11	72	52
Animal husbandry	Points	74	12	83	53
Nutrient flows	Points	25	13	39	5
Water use	Points	46	11	60	33
Energy & Climate	Points	6	2	9	4
Biodiversity & Plant protection	Points	36	7	42	28
Working conditions	Points	58	9	69	44
Quality of life	Points	71	5	76	62
Economic viability	Points	46	19	61	18
Farm management	Points	64	7	71	52

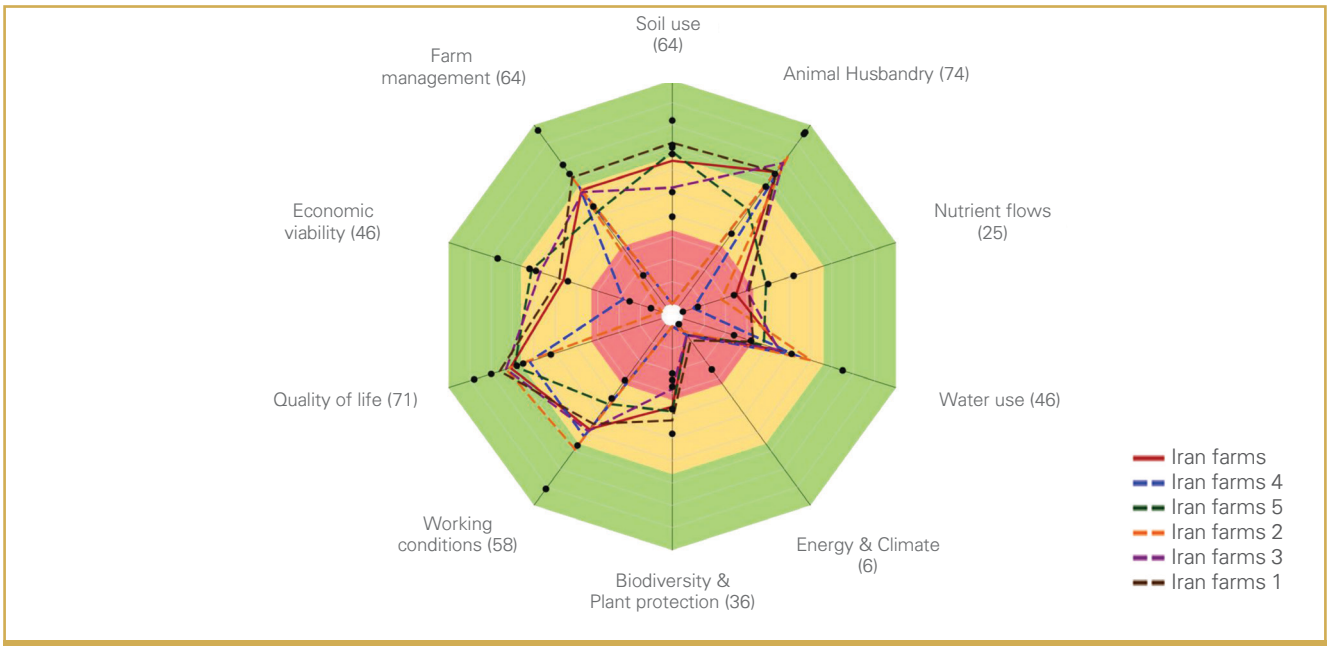


Fig. 4. Average indicator scores of all farms (red line), and individual scores of the five farms analysed in Quazvin region, Iran. Concerning the Soil and Economic viability indicators, scores at 0 are due to missing values (no agricultural areas, and no financial data respectively). For technical reasons, scores are set at 0 points. They were not considered for calculation of indicator average score.

The black dots at the sustainability polygon (Fig. 2, 3, 4) represent **average** parameter scores which are sub-themes of indicators. Large spread of parameter scores occurred at *Economic viability, Water use, Nutrient flows, and Animal husbandry.* This may lead to the situation that good parameters in the green zone may outbalance the bad performance in other parameters, resulting in indicator scores in the mid-range.

Parameters in the green zone that positively stood out were:	Important parameters in the red zone of the polygon were:
• *Supply and yield security* indicating stable production conditions • Quality of housing in *Animal husbandry* indicating principally animal friendly shelters for livestock • Livestock productivity at *Animal husbandry* and Crop productivity at *Soil use* indicating yields above regional average • Personnel management at *Working conditions* indicating regulated and documented conditions • Water supply at *Water use* indicating sufficient access to water for the analysed farms • Planning instruments and documentation at *Farm management* indicating professional documentation of farming activities	• Energy intensity of agricultural production, and Share of sustainable energy carriers in *Energy & climate* indicating use of high amounts of diesel and electricity both from non-sustainable sources • Greenhouse gas balance in *Energy & climate* indicating high emissions of gases affecting climate Main emitting sources are the cattle production and the energy carriers • Waste management in *Nutrient flows* indicating problematic treatment of wastes causing environmental pollution • Liquidity at *Economic viability* indicating critical financial capacities • Ammonia emissions at *Energy & Climate* indicating high emissions due to manure management • Nitrogen balance at *Nutrient flows* indicating inefficient nutrient use in crop production • Water and energy management at *Water use* and *Energy & climate* indicating low management priority because of insignificant costs • Salary level at *Working conditions* indicating low salaries that are compensated with long working hours

4.2 Results (major issues) and interpretation

4.2.1 Soil use

Rationale: Fertile soils are a limited, easily degradable basis of life and production. This indicator reflects the state of soils on the farm and the impact of farming practices on the soil quality.
It answers the following questions:

- How is the fertility of my soils rated?
- What impacts do my farming practices have on soil fertility?

Tab. 3. Soil use: Indicator and parameter values and the average of the three farms analysed with RISE in Qazvin province, 2015. Note that the results are not based on direct measurements of soil parameters (e.g. pH, pollutants, humus contents), but deducted and estimated from the applied farming practices. The other two farms were not assessed for this parameter, as they did not practice crop production.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Soil use	**Points**	**72**		**52**		**68**	**64**
Soil management	**Points**	84		67		50	67
Loss of agricultural area in the past 10 years	Points	*100*		*100*		*100*	*100*
Knowledge and up-to-date information about soil fertility	Points	*67*		*33*		*0*	*33*
Crop productivity	**Points**	77		82		88	82
Yield level crop production (min. 0, max. 100)	Points	*77*		*82*		*88*	*82*
Soil organic matter supply	**Points**	29		45		43	39
Share of area with high soil organic matter content (of total area)	Points	*0*		*0*		*12*	*4*
Soil organic matter balance in arable crops	Points	*57*		*90*		*73*	*73*
Soil reaction	**Points**	100		13		100	71
Soil pollution	**Points**	90		60		60	70
Soil erosion	**Points**	75		45		82	67
Water erosion	Points	*75*		*67*		*82*	*75*
Water-erosion risk in most vulnerable production system (100 pts. = lowest risk)	Points	*50*		*34*		*64*	*49*
Share of surface with observed water-erosion	Points	*100*		*100*		*100*	*100*
Wind erosion	Points	*90*		*45*		*87*	*74*
Wind-erosion risk in most vulnerable production system (100 pts. = lowest risk)	Points	*80*		*33*		*86*	*66*
Share of surface with observed wind-erosion	Points	*100*		*56*		*87*	*81*
Soil compaction	**Points**	50		50		50	50

In general, the sustainability of Soil use was positively rated for two of the three farms (Tab. 3, and Tab. 2). Good crop yields positively stand out at the analysed farms. The other two farms were not practicing crop production, hence this parameter was not studied for these farms.

Soil management

Three of the five farms were active in both dairy and crop production. The two other farms were only active in dairy production. One of them stopped crop production because of insufficient water availability.
According to the farm managers all farms regularly made soil analysis for the determination of soil pH and nutrient status.

However, observed fertilization regimes (e.g. stereotypic application) lead to the conclusion that fertilization was not applied according to effective nutritional state of the soil and requirement of crops. Fertilizer surpluses would be a waste of resources and money, with negative impact on the environment.

- It is recommended to continue with regular soil analysis, and as a next step, to build capacity in accurate fertilization planning. It would be helpful when official extension services could support farmers in this task.

Crop productivity

Thanks to irrigation and partly excessive fertilizer application crop yields were found to be above regional average at two of the three farms. One farm had a deficient lateral irrigation system. As a consequence, the crops suffered from heat stress and drought.

- It can be expected that yields can be increased with optimized fertilization regimes, as well as improved crop rotations (including leguminous crops).

Soil organic matter supply

Soil organic matter (SOM) is regarded as one of the key aspects determining the productive potential of soils. None of the soils contains high SOM contents of above 4% and therefore for this part of the parameter, the score is in the problematic zone.

Soil organic matter balance in arable crops was rated medium to positive. However, because of the reasons discussed below, it is expected, that the situation of SOM could become worse. As farmers frequently applied manure only in alfalfa. There were large areas with grain crops that never received any manure or were cropped with green manure crops such as alfalfa. According to the rough VDLUFA[1] method used in RISE, silage maize and grain crops were regarded as crops with significant humus reducing effects. Humus decomposition was expected to be highest in maize at a rate of about minus 800kg humus-C per hectare and year. For grain crops it was still minus 190kg. The leguminous plant alfalfa has a positive effect on SOM content at a rate of plus 800kg humus-C. However at farm level the positive effect of alfalfa was rather small as the crop was planted only on comparably small areas. Furthermore, the crops were regularly burned for the control of the alfalfa weevil (Fig. 5). Burning destroyed most aboveground biomass, thereby reducing the positive effect on SOM.

- The use of manure for improving SOM is an important measure to maintain soil fertility. It is recommended to use more organic fertilizers in arable crops. Manure could be applied fresh before cultivation of soils. Liquid manure could also be applied, but a proper application technique is key to protect the environment. Furthermore, it is recommended to plant more leguminous plants like clover, sainfoin, or *Vicia villosa*. Manure can be applied to all crops and not only to alfalfa (as it is currently practiced).

Fig. 5. The control of the alfalfa weevil includes insecticide treatment and periodical burning of the crop.

Soil reaction

Soil pH is throughout estimated to be in the optimum range to slightly alkaline, i.e. between 5.5 and 7.0, and respectively between 7 and 8. Used mineral fertilizers, like Urea or DAP usually have pH lowering effects. For alkaline soils there is low risk for too low soil pH.

Whereas for neutral soils it is recommended to regularly carry out soil analysis and if necessary counter measures should be taken like liming, or change of fertilizer type.

Soil pollution

Farms using phosphorous fertilizers must be aware that these fertilizers may contain heavy metals as impurities, like cadmium, copper, zinc, nickel, lead or chromium. The more phosphorus fertilizers are used, the higher is the concentration of heavy metals in agricultural products[2]. Farms use only small amounts of antibiotics which reach the manure and the soils.

- It is recommended to replace certain share of mineral by fresh solid manure and by liquid manure. This helps save money and resources.

Irrigation in arid areas may bring salts to the surface in the

1. VDLUFA = Verband der landwirtschaftlichen Untersuchungs- und Forschungsanstalten; the German association of agricultural research laboratories, where this method to calculate the association of agricultural research laboratories, where this method to calculate the SOM balance was developed.

2. Grant CA, Bailey LD, Harapiak JT, Flore NA (2002) Effect of phosphate source, rate and cadmium content and use of *Penicillium bilaii* on phosphorus, zinc and cadmium concentration in durum wheat grain. Journal of the Science of Food and Agriculture 82, 301-308

absence of enough leaching. Plots do not have drainage systems and therefore there is certain risk for salinization of the soils.

- It is recommended to practice soil salinity control involving water table control and flushing to wash excessive salts away from the soils[1].

Soil erosion

No water erosion events were identified. The terrain was flat, but with threat of capping.
Wind erosion is more difficult to detect. Some farm managers reported such events. Soils were particularly prone after soil preparation and seeding. Irrigated fields were less prone. The risk for wind erosion can increase due to increasing desertification.

- In regions with progressing desertification it is recommended to plant wind breaks and to apply soil and water conserving practices like no till, reduced tillage as well as soil preparation with cultivator instead of ploughing.

Soil compaction

Heavy machines were used, such as combined harvesters during harvest. However, soils were usually dried up in this process, therefore the risk for soil compaction was estimated to not be very high.

4.2.2 Animal husbandry

Rationale: Livestock are an integral component of many agricultural production systems. Animals have to be kept in an environmentally unproblematic and species-appropriate way. The latter encompasses the "five freedoms": freedom from hunger and thirst, from discomfort, from pain and disease, from constraints to natural behaviour, and from fear and distress (FAWC, 1979). At the same time, a high performance and resource efficiency are aimed for.
This indicator reflects:

- Whether livestock performance is at a high level
- Whether livestock husbandry systems allow for species-appropriate behaviour
- Whether the physiological needs of the animals are met
- Whether animals live a healthy life.

Tab. 4. Animal husbandry: Indicator and parameter values as well as the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Animal husbandry	Points	74	83	79	82	53	74
Herd management	Points	83	83	83	83	33	73
Livestock productivity	Points	96	94	99	88	99	95
Possibility for species-appropriate behavior	Points	37	100	100	94	0	66
Quality of housing	Points	100	100	100	99	80	96
Animal health	Points	52	37	15	44	54	40

Dairy production was the main business of the analysed farms. Hence the Animal husbandry indicator is key to the success of these farms.

Herd management

The intensity level of the dairy production systems was high at the studied farms. The production systems with high yielding Holstein cows required a high level of professionalism and good herd management. Most farms were strong in this aspect, for example they regularly observed the animals and treated them when required or cleaned the barns properly. However, on one farm there were signs of neglected animals.

- For this farm, it is recommended to invest in the modernization of infrastructure, to increase skilled workforces for better management of the animals and to regularly consult external experts.

Even on the best farm one or several problematic areas could be identified. Usually, these areas were related to deficient infrastructure, or to improper animal care.

- It is recommended to regularly inspect production sites by internal and external staff and to take measures in case of problems. Staff at all levels should be encouraged to contribute to the improvements.

1. Salt-Affected Soils and their Management, FAO Soils Bulletin 39 (http://www.fao.org/docrep/x5871e/x5871e00.htm)

According to the responsible persons at the farms, the selection of the semen nowadays focuses on the health criteria, lifetime net merit or productive life, as goals in milk yields were already reached. This means that the aim for high performance was the reason for selecting the Holstein breed. Milk output thereby got higher attention, than other criteria like robustness and longevity.

- It is further recommended to evaluate alternative breeds and lineages considering quality criteria going beyond milk productivity. Thereby, the overall input (fodder, concentrate and medicine) - output (milk, meat) performance should be considered with full-cost accountings.

Livestock productivity

For the used Holstein breed milk productivity was average to high, ranging from 10'000kg to 13'800kg of milk per lactation. Farmers mentioned that yield either remained stable at high level, or that it increased in the last years due to improved management, or due to increased age of the cows. Beside milk, the production of meat was an important income source for the farms. For the Holstein breed, the daily growth rates were average; but compared to other breeds the performance was below-average.

- Beside the genetic component of the breeds, management and environment have major impact on performance.
  - It is therefore recommended to invest in cow comfort (temperature, shade, bedding, milking parlor, etc.) and good management (cleanness, fodder and water availability, hoof grooming).
- Another aspect of livestock productivity is also the pregnancy rate. At all farms oestrus was timed with treatment with hormones. It is known that this method is cost intensive and usually leads to lower pregnancy rate than observation of the signs of heat of the cows.
  - It is therefore recommended to critically evaluate this system. Maybe tests and comparisons with a separate group of cows could be conducted in order to get experience in this field.

Possibility for species-appropriate behaviour and Quality of housing

Cow comfort includes also that livestock get the possibility to behave according the species-specific nature. Infrastructure and management determines the level of comfort of the livestock.

The best husbandry system for cows is when they have access to pastures. However, the used free stall and barns and open shed stalls allowed the cows to satisfy quite many of their basic needs. Therefore, most farms were positively rated in these two parameters, as there was good availability of water, clean air, enough space, light, and no technical noise. However, below there are examples of observations requiring further improvements.

- Cattle are social beings and particularly calves need to have contact to conspecifics. In order to prevent diseases from spreading and mainly for diarrhoea preventions, calves were separated for some time. On some farms calves were too isolated and contact was impeded by the constructions (Fig. 6).
  - It is recommended to improve contact possibility by enlarging the windows openings in the calf boxes and to lower the height of the walls (Fig. 7).

Fig. 6. Calves in some boxes were too isolated. In this box straw is missing for comfortable bedding.

Fig. 7. Boxes with low walls allow calves to have contact to conspecifics.

- Sometimes calves and heifers were kept too long in separated boxes. There is no scientific evidence that separation would accelerate growth and sexual maturity, as claimed by the farm managers. In contrary, calves and heifers kept in groups suffer less from isolation stress and therefore perform better (Fig. 8).
  - It is recommended to keep calves and heifers in small groups after 1 month (Fig. 9).
- In one place calves were kept in quite small cages with plastic pads onto the mesh net floors. In some cages pads were slipped and animals stood or lied on the coarse mesh net (Fig. 10).
  - It is recommended to improve the management of these cages or to replace them by better systems in order to improve comfort of the calves.
- There were partly problematic hygienic situations. There were parts of stables, like walkways (Fig. 11), beddings (Fig. 12), or boxes (Fig. 13) that were not sufficiently clean and cows did not find clean places to lie down. Such beddings may enhance risk for mastitis.
  - It is recommended to clean surfaces frequently and to offer soft, clean and dry beddings.

Fig. 8. At one farm heifers were kept in separated boxes.

Fig. 10. Mesh net cages maybe uncomfortable for the calves and therefore be a stress factor.

Fig. 9. Living in groups meets the needs of cattle.

Fig. 11. Some places in the stables like this walkway were dirty.

- Some drinking troughs were dirty, or did not contain enough water (Fig. 14). Cornered basins are more difficult to clean than round-shaped (Fig. 15).
- It is recommended to clean the drinking troughs every day. For comfortable drinking, depth of water should be at least 20 cm with a water flow of about 10-20l/minute. For best performance calves should have permanent access to clean water or they should get water at least three times a day (Fig. 16). Same as water, also feed should be regularly offered to the cows in order to enable sufficient fodder uptake (Fig. 17).

Fig. 12. Dirty beddings are a source for pathogens causing mastitis.

Fig. 13. Wet and dirty boxes at calves.

Fig. 14. Leftovers in drinking trough

Fig. 15. Rectangular drinking troughs are more difficult to clean than round shaped ones.

- Effective fly control is important to relieve cows and to keep them calm. Practices that should be avoided are to spray insecticides over the manure or to openly spread insecticide powder on the floor, as people and animals may come in contact with it (Fig. 18, Fig. 19).
- Infrastructure was partly deficient on some farms. For example nozzles of water sprayers were clogged or leaked (Fig. 20), or sun sheds were missing (Fig. 21).
  - It is recommended to regularly maintain infrastructure.

Fig. 16. Water pans have to be cleaned regularly.

Fig. 19. Trap with attractant and insecticide not accessible for humans and animals.

Fig. 17. Cows waiting for fodder.

Fig. 18. Traps with sticky plates or liquid attractants

Fig. 20. Leaking sprayers made floors wet and slippery

Fig. 21. When sun sheds were missing cows were exposed to the sun.

Fig. 22. Crowding cows in a shed

- At some places cows were overcrowded for example at the feed or water places (Fig. 22).
  - It is recommended to check the cause for crowding, as for example weak animals may be displaced from fodder or water, and consequently have a reduced performance. Fodder should be regularly distributed, offering enough feed places also for weak animals (Fig. 23).

Fig. 23. When there are not enough feed places or fodder is distributed irregularly, weak animals may be displaced.

- For farms with animal welfare problems, it is recommended to engage vets and periodic visits of professional consultants. Furthermore, educations can help improving the skills of workers. At periodical intervals, there should be systematic analysis of the situation and search for the root cause of the problem. In a next step, clear targets, responsibilities and time frames should be defined.

Animal health

Closely related to animal comfort are also the health issues. The analysed farms were rated in the yellow to red area in the animal health parameter. The general high intensity of the production systems is to blame for the high susceptibility to health problems. The herds were all relative young with an average of 2.5 lactations per cow. Regular use of antibiotics is common practice and high culling rates as well. Concerning antibiotics cows were prophylactically treated against mastitis. Usually, they were not curatively treated in case of inflammations or diseases; in this case they were culled. Resistance problematics in livestock and human medicine makes it imperative to reduce antibiotics to a minimum. Good management practices like liming the manure bedding, or regularly cleaning the stables help to reduce the risk for infections. The preventive antibiotic

treatment of cows 1 to 2 weeks before calving should be stopped, as this is not according to good practice. The hooves were well and regularly groomed at all farms visited. Beside the preventive antibiotic use, there were further observations requiring consideration:

- Some farm managers complained of high abortion rates, between 8 and 12%.
  - Abortion may have many causes. Nonetheless, the losses were significant, it is recommended to search for root cause together with veterinarian and extension services.
- Dehorning was made by cauterization with ointments of the horn forming tissue. The advantage of the system is the relatively easy application of the ointment. However, the cauterization is a long-lasting process, causing pain and stress for the calves.
  - It is therefore recommended to change to less straining procedures, like burning the horn forming tissue. This procedure is more invasive, indeed, but the calves are pain free within short time. For the burning, the calves are locally sedated.
- When heifers from other herds were bought they sometimes had horns. The animals were locally sedated as well and then the horns were cut with a wire saw.
  - It is recommended to remove horns, or the horn forming tissue as young as possible to reduce stress and minimize animal welfare concerns. If possible calves or heifers with horns should not be bought.
- Cows in some farms were constantly kept under sun shelter and were never exposed to the sunlight. It is known that this may increase fungal and skeletal problems.
  - It is recommended to offer cow access to sun.
- On some farms small rubbish lied around, accessible for cows (Fig. 24). Such foreign objects can cause severe health problems when ingested.
  - It is recommended to sensitize workers to the threat of such objects and to sustainably dispose the rubbish.
- Disinfection dips were sometimes not openly accessible and were sometimes too small (Fig. 25).
- The first two hours in a calf's life are crucial for its immunization and resistance against pathogens. Within that time the calf has to get mother cows' colostrum at sufficient quantities. There is scientific evidence that the composition of the colostrum is best adapted to the local pathogens the longer the mother cow lived at that place.
  - It is therefore recommended to supply the calf with colostrum as quick as possible (Fig. 26).

Fig. 24. Rubbish may cause health problems when ingested.

Fig. 25. Disinfection dips should be large enough and prominently placed

Fig. 26. Quick supply of colostrum is crucial for the calf's immunization.

4.2.3 Nutrient flows

Rationale: A sustainable agricultural production makes use of natural nutrient cycles. Nutrient flows should be well-balanced and contribute to a high level of productivity. Emissions of harmful substances as well as waste production should be minimized.
This indicator deals with:

- Nitrogen and phosphorus balances at farm level
- Ammonia, nitrate and phosphate emissions caused by agricultural production on the farm
- The quality of farm waste management

Tab. 5. Nutrient flows: Indicator and parameter results as well as the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Nutrient flows	**Points**	**31**	**18**	**30**	**5**	**39**	**25**
Nitrogen balance	**Points**	30	0	91	0	78	40
Phosphorus balance	**Points**	75	90	9	6	79	52
N and P self-sufficiency	**Points**	50	0	27	18	26	24
N-self-sufficiency: Animal husbandry and Crop production	Points	*50*	*0*	*27*	*18*	*25*	*24*
P-self-sufficiency: Animal husbandry and Crop production	Points	*50*	*0*	*26*	*18*	*27*	*24*
Ammonia emissions	**Points**	0	0	23	0	12	7
Ammonia emission risk: Animal husbandry and farm-manure	Points	*0*	*0*	*7*	*0*	*0*	*1*
Animal density	Points	*0*	*0*	*33*	*0*	*1*	*7*
Animals on pasture land or non-concrete ground	Points	*0*	*0*	*0*	*0*	*0*	*0*
Ammonia emission risk: Mineral fertilizers	Points			*72*		*37*	*55*
Waste management	**Points**	0	0	0	0	0	0

The Nutrient flows indicator was in the red zone, because of inefficient use of available nutrients as well as emissions of nutrients and wastes to the environment. With regard to the sustainability goal towards closed nutrient cycles, the analysed farms had very high nutrient losses on the one side and on the other side high dependency on nutrient imports (fodder, mineral fertilizer) from outside the system. Measures for improvement of the current situation should reduce both, the loss of nutrients and dependency on nutrient imports. This would not only be environmentally, but also economically beneficial.

Nutrient balance (Nitrogen and Phosphorus) and Ammonia emissions

It is not possible to calculate the exact nutrient flows under the prevailing conditions, as there are uncertainties concerning the husbandry systems; manure separation process; manure storage and application as well as concerning the crop yields. Therefore, the calculated numbers in RISE must be treated as estimations of the real situation. If exact figures of the nutrient flows are needed, measurements need to be conducted of the particular nutrient inputs and outputs, together with detailed soil analysis. Nonetheless, from our rough analysis based on the available data and interview, it can be stated that there must

Fig. 27, 28, 29. There are high ammonia emissions to the air from hot and wet places with faeces.

Fig. 30, 31. Frequent removal of manure let the floor dry and reduce the ammonia emissions.

be substantial losses of nitrogen from nitrogen evaporation (mainly ammonia, nitrous oxide) and leaching (ammonium, nitrate). The main reason is the poor manure management. According to the RISE calculations nutrient flows were mostly imbalanced on the analyzed farms (Tab. 6, Tab. 7). There are either nutrient surpluses on some farms or deficiencies on other.

Typical manure management consisted of collection of solid and liquid manure, separation of the two fractions, drying and application of the dry fraction to the field, or selling of dry manure to other farms. Only one farm used also the liquid fraction as fertilizer. In this case they further diluted the liquid fraction and distributed it with the irrigation system. It is notable that this farm had the smallest nitrogen losses and therefore used this valuable resource in the most efficient way. For the environment and ground water in particular, this practice did not impose a threat, as nitrogen was fixed by the growing plants. The common practice of separation and drying of manure practiced on the other farms is a higher risk to the environment.

- It is therefore recommended to test the application of liquid manure, and adapt available techniques to the local conditions in Iran. Further, the responsible staff at the farms should be trained in better manure management and proper reuse of manure. This would require assistance in appropriate stables, storage facilities and techniques for bringing the manure to the fields. Some farmers also expressed their interest in installing biogas digesters, which would additionally reduce e methane emissions. Improved nutrient management strategies, including the calculation of simple N, P and K balances, is recommended.

Fig. 32. Emissions from storage of solid manure.

Tab. 6. Calculated nitrogen (N) supply and demand on five dairy farms analysed with RISE in Qazvin region in 2015. All figures in kg.

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Average
N from livestock total (kg N)	**43,695**	**293,023**	**195,900**	**197,025**	**76,650**	**161,259**
N from livestock excl. volatile N loss (kg N)[1]	14,429	87,907	162,680	59,108	78,700	80,564
Mineral fertilizers (kg N)	**0**	**0**	**63,440**	**0**	**37,600**	**20,208**
Bought organic fertilizers (kg N)	**0**	**0**	**0**	**0**	**0**	**0**
N fixation by legumes (kg N)	**570**	**0**	**29,070**	**0**	**15,105**	**8,949**
atmosphere emissions (kg N)[2]	**750**	**0**	**11,400**	**0**	**3,000**	**3,030**
N removal total (crops and export) (kg N)	**30,120**	**27,000**	**139,478**	**225,000**	**102,842**	**104,888**
N removal from crop yield (kg N)	30,120	0	139,478	0	73,100	48,539
N removal from manure export (kg N)	0	2,7000	0	225,000	29,741	56,348
Balance 1 (kg N)	**-15,691**	**60,907**	**23,202**	**-165,892**	**-24,142**	**-24,323**
Agricultural area (ha)	50	0	760	0	200	202
Balance 2 (kg N/ha)	-314		31		-120	-120
Balance 3 (%)	48	326	117	26	77	119

1. It is expected that volatile losses reaches 70% of total N produced by livestock. The losses include also losses to the soil and ground water.
2. Atmospheric emission was estimated to be 15 kg of nitrogen per hectare and year based on Galloway et al. (2008).

Tab. 7. Calculated phosphorus (P) supply and demand on five dairy farms analyzed with RISE in Qazvin region in 2015. All figures in kg.

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Average
Livestock excretion	6,752	45,447	30,360	30,508	11,973	25,008
Mineral fertilizers	0	0	11,834	0	5,934	3,554
Bought organic fertil.	0	0	0	0	0	0
P removal total (crops and export) (kg N)	5,288	54,000	24,318	90,000	23,071	39,335
P removal from crop yield (kg P)	5,287	0	24,318	0	12,716	8,464
P removal from manure export (kg P)	0	54,000	0	90,000	10,355	30,871
Balance 1 (kg)	1,464	-8,552	17,876	-59,491	-5,164	-10,773
Agricultural area (ha)	50	0	760	0	200	202
Balance 2 (kg/ha)	29		24		-26	-53
Balance 3 (%)	128	84	174	34	78	99

Self-sufficiency

- The studied farms were highly dependent on external supply of feed. The situation for farms with crop production was less serious but the dependency on external feed supply was still substantial. Due to inefficient manure management, nutrient requirements were either covered with fertilizer imports or the soil nutrient stock could be depleted.
- Cooperation with other farms could help to mitigate high dependency on external supply. Losses could be reduced by using manure more efficiently and by planting leguminous plants as cover crops for N-fixation. It should be explored whether leguminous shrubs or trees can be introduced and planted along the plot margins. This would not only protect the soil but also increase the soil nutrient content.

Fig. 33. Collection and separation of wastes for recycling. Good practice

Waste management

Waste management was rated as problematic for all farms. Although many types of wastes were treated in environmental friendly way, still some practices impose high risks for the environment.

Particularly problematic is the burning of wastes, like plastics, as highly toxic pollutants (dioxins) are thereby emitted to the environment (Fig. 34, 35, 36). In the worst case, pollutants reach fodder and contaminate agricultural products. Even wastes supposed to be harmless when burned, like paper, carton and wood may emit highly problematic toxins, as they may be coated or treated with chemicals.

Problematic is also the treatment of cadavers at the farms. They were deposed somewhere or buried. This is a risk for

Fig. 34. Wild waste disposal and places where wastes are burned

Fig. 35, 36. Wild waste disposal and places where wastes are burned

Fig. 37. Burying cadavers threatens water resources.

water and spread of diseases (birds, flies, rodents) when not covered by soil.

The unsustainable disposal of liquid wastes is also problematic, for example the cleaning agents from the milking machine. Some of the farm managers were aware of the environmental risks and built waste water treatments.

For some wastes like plastics, metal, glass or tires there is a market for used products. Therefore, such wastes were collected, separated, and sold to waste dealers (Fig. 33).

- We therefore suggest establishing a coherent waste management concept for proper and safe waste treatment and implement effective measures.

4.2.4 Water use

Rationale: Clean water is an indispensable basis for human life as well as crop and livestock production. Through the production system, the farmer can have a direct impact upon the amount and quality of water available to other users within the same watershed.
This indicator shows:
- How well the farm is supplied with clean water
- How intense and efficient water is used for production
- Whether water use and wastewater disposal on the farm impose risks for water resources and their users

Tab. 8. Water use: Indicator and parameter values as well as the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Water use	**Points**	**33**	**60**	**45**	**53**	**38**	**46**
Water management	**Points**	22	55	42	17	25	32
Water supply	**Points**	63	83	63	83	83	75
Water use intensity	**Points**	7	44	7	53	7	24
Regional moisture index (water availability)	Points	*13*	*13*	*13*	*13*	*13*	*13*
Water use intensity	Points	*0*	*75*	*0*	*92*	*0*	*33*
Risks to water quality	**Points**	40	57	66	57	37	51
Risks to water quality coming from storage facilities (silage, manure) and waste water	Points	*13*	*13*	*75*	*13*	*13*	*25*
Risk for nutrient input into water (Animals entering water, erosion, areas with high nutrient input)	Points	*67*	*100*	*56*	*100*	*61*	*77*
Nutrient input into water caused by erosion	Points	*100*		*67*		*82*	*83*
Water erosion	Points	*75*		*67*		*82*	*75*
Areas with high nutrient input	Points	*0*		*0*		*0*	*0*

The water use indicator was mostly in the yellow or red area. Current water availability at the analysed farms was generally good, but there are critical issues for the future water availability. Further risks for water pollution were identified due to poor waste water treatment and manure management.
Long term water availability is the most critical factor for all agricultural activities in the region. According to the interviewed farm managers, the ground water table drops by 0.5 – 0.7m per year. This is an alarming situation and it is obvious, that in near future access to water will become a virulent issue in the region.
The analysed farms were large farms with solid financial means. For them, the situation was not yet alarming. Actually they handle the problem by drilling deeper boreholes (up to 120 m depth). It is evident that farmers with limited financial means cannot follow and will lose their base for production. There is an ongoing desertification process in the region. At one farm agricultural activities were reduced because of declining water availability. Desertification is a self-reinforcing process by affecting the vegetation cover in the region, making local climate hotter, dryer and windier.
Regarding the growing water crisis, it is astonishing that the price for water was still very low. Therefore, for the farm manager there was no need for saving water, from a (short term) financial point of view. As the large farms were organized as companies, employed farm managers were measured by their short term achievements. What was missing was the long term perspective and responsibility of the management. It is therefore a task for the authority to impede harmful practices and effectively regulate and control water use in the region and between regions.
As mentioned above, water is not an important cost factor

and therefore, not much attention was given to the **water management**. This means that water consumption was not consciously monitored. Hence, low efficiency irrigation systems were in place (furrow irrigation (Fig. 39), overhead sprinkler systems and high pressure center pivot). Crops with high water requirement were cultivated, like alfalfa.

- Plant crops requiring less water like sorghum, clover and sainfoin. Soils were plowed. This is intensive soil treatment
- Use non-turning techniques like subsoilers instead and further soil and water conserving techniques
- It is recommended to promote improved irrigation systems like Low Energy Precision Application (LEPA) or subsurface drip irrigation systems (SDI)[1,2].

But also the irrigation practice of the farmers determines the efficiency of water use. People in charge should be sensitized and trained in improving their irrigation practice (e.g. irrigation at night, irrigation according to the requirement of the different plant development stages (Fig. 38). Such trainings could be organized by the official extension services.

Fig. 38. Demand driven irrigation regime would help reducing water consumption. Water intensive irrigation systems could be replaced by more efficient systems.

Fig. 39. Furrow irrigation is a widespread irrigation technique.

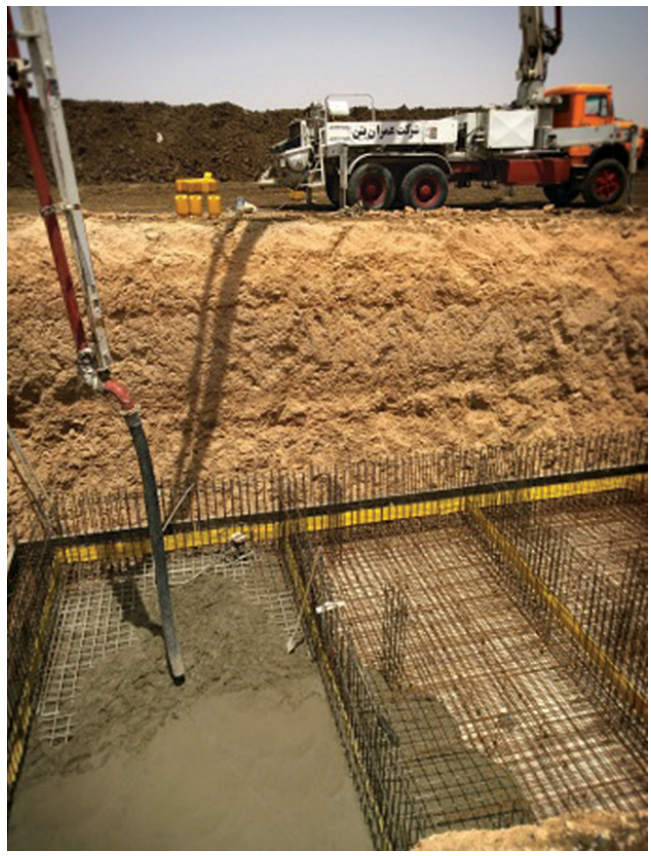


Fig. 40. Construction of a sewage system for reusing waste water e.g. for irrigation of the green zones at the farm.

1. Lamm F. Advantages and disadvantages of subsurvace drip irrigation. Kansas State University http://ucanr.edu/sites/adi/files/204430.pdf
2. Payero J., Yonts C., Irmak S., Terkalson D.. Advantages and disadvantages of subsurface drip irrigation. University of Nebraska. http://www.ianrpubs.unl.edu/live/ec776/build/ec776.pdf

Fig. 41. After separation liquid fraction of manure evaporates to the atmosphere or percolates to the soil.

Fig. 42. Polluted water leaving the farm in an open water channel.

Fig. 43. Effluents from silage respectively manure can percolate to the soil.

Risk to water quality

An important issue regarding this parameter was the uncontrolled percolation of liquid manure to the soil (Fig. 41), and to smaller extent to run-off waters on some farms (Fig. 42). On farms using water from water channels polluted water was sometimes used downstream again for irrigation.

- It is recommended to store both manure and silage on concrete plates and to collect possible run-off, as practiced on some farms (Fig. 43, 44, 45).

Fig. 44. Effluents from silage respectively manure can percolate to the soil.

Fig. 45. Concrete plate effectively hinders silage effluents from percolation to the soil.

4.2.5 Energy & Climate

Rationale: To be sustainable, agricultural production has to be energy-efficient and independent from non-renewable, environmentally harmful energy carriers. This also serves to safeguard climatic conditions conducive to the health of plants, animals, humans and ecosystems.
This indicator shows:

- How energy-intensive the agricultural production is,
- To what extent does energy depend on non-sustainable energy carriers,
- What energy-saving measures have been implemented,
- How agricultural production on the farm contributes to global warming.

Tab. 9. Energy & Climate: Indicator and parameter values as well as the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Energy & Climate	Points	**9**	**4**	**6**	**6**	**6**	**6**
Energy management	Points	35	15	25	25	25	25
Energy saving measures	Points	*35*	*15*	*25*	*25*	*25*	*25*
Energy intensity of agricultural production	Points	0	0	0	0	0	0
Share of sustainable energy carriers	Points	0	0	0	0	0	0
Greenhouse gas balance	Points	0	0	0	0	0	0

The five farms score low on the Energy & climate indicator (Tab. 9). Main reason for this result was the high energy consumption, almost exclusively from non-renewable sources, and high emissions of greenhouse gases. On all the analysed farms, the energy consumption lied clearly above country average (5'000 MJ/ha) due to high intensity of dairy and agricultural production (around 100'000 MJ/ha). Similar to the issues regarding the Water use indicator, there was no active management of the energy resources and at most farms only few energy saving measures were in place. Again, low prices may explain the disinterest in this topic. Nonetheless, the finiteness of fossil energy carriers and the mitigation of global warming are strong arguments for taking actions to improve the current situation.

- For the farm management it is recommended to yearly monitor the energy consumption. Targets should be set and lines of action should be defined. When purchasing new devices like machinery or for future infrastructure developments, energy efficiency should be one of the key selection criteria.

There are two major lines of action:

1. Reduction of energy consumption. The energy saving potential in dairy production is significant. Electricity is mainly used for pumping (vacuum), cooling the milk and for heat control of the barns. For all purposes improved technologies are available and occasionally used at some of the visited farms. For example one farmer used a frequency controlled vacuum pump, reducing the energy need for creating the vacuum by half.
   For cooling milk, the energy saving potential is high, as well. For example there are systems with plate heat exchanger that pre-cool the milk before reaching the milk tank. Furthermore, cool water is heated up with the warm milk and the warmed water can then be used e.g. for cleaning the milking parlor or as warmed drinking water for the calves. Another system is heat absorption chillers e.g. from solar thermal collectors or biogas digesters, for cooling the milk. It is recommended to contact suitable companies[1] in Iran for technical advice for the local conditions in Iran.
   Also for controlling the barn climate, simple systems may reduce energy requirement considerably. Properly designed barns enable natural ventilation thereby relieving performance of mixing fans. For example open ridges in free stall barns allow hot air to escape quickly from the roof's underside.
   Energy use for lightning is lower than the requirement for cooling. Nonetheless, saving potential of energy saving bulbs is enormous. Compared to classical halogen headlights, LED headlights only use one tenth of electricity.

2. Replacement of non-renewable with sustainable energy carriers (Fig. 46).
   Despite the current use of cheap electricity from fossil sources, simple and effective systems exist helping to reduce dependency on fossil energy. Due to high solar irradiation in the region, there is a great potential to achieve high yields in photovoltaic plants and solar thermal collectors. However, because of low energy prices of regular electricity sources, alternative systems require governmental support, particular in the investment phase. Hot water from solar thermal collectors could be used for cleaning the milking parlor and milking machines.

Concerning the greenhouse gases (GHG), the bulk of emissions occurred as methane excreted by the dairy cows, followed by emissions from energy use (Tab. 10). Around three-quarter of all CO2-equivalents were emitted by the dairy cows and their offspring. The calculated greenhouse gas emissions ranged from 1787 to 7986 tons of CO2. Looking at the three mixed farms, emissions were clearly above the global agricultural average of around 2.4 tons of CO2 equivalent per hectare (Grenz et al., 2011). This underlines the high concentration of ruminants in these production systems.

Fig. 46.. Under the climatic conditions in Iran solar panels effectively produce "green" electricity.

1. E.g. products of DeLaval for energy efficient products: http://www.delaval-us.com/About-DeLaval/Sustainability/Sustainable-Dairy-Farming/Solutions/
   Sales contact for DeLaval products: IKAD TRADING NETWOR Company, 4th floor, No2, Asghari Alley, FelestinStr, IRAN
   Phone: +98 21 66490207, Fax: +98 21 66490208; agriservis@yahoo.com

Tab. 10. Sources of gross greenhouse gas emissions on dairy farms in Qazvin region by source.

	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Average
Total GHG emissions (t $CO_{2\text{-eq}}$)/ha	**36**		**8**		**21**	**25**
Total GHG emissions (t $CO_{2\text{-eq}}$)	**1,787** **100%**	**7,986** **100%**	**6,091** **100%**	**5,385** **100%**	**4,184** **100%**	**5,087** **100%**
From animals (t $CO_{2\text{-eq}}$)	1,113 62%	6,948 87%	4,715 77%	4,741 88%	1,826 44%	3,869 76%
From energy use (t $CO_{2\text{-eq}}$)	621 35%	808 10%	990 16%	1,262 23%	2,178 52%	1,170 23%
From mineral and organic fertilizers (import&export) (t $CO_{2\text{-eq}}$)	54 3%	227 3%	606 10%	-618 -11%	182 4%	90 2%
C sequestration through measures in crop production (CO2) (t $CO_{2\text{-eq}}$)	-3 0%		-220 -4%		-1.5 0%	-56 -1%

Lines of action for reducing greenhouse gas emissions may include:

- The production of methane in biogas digesters (Fig. 47).
- Replacement of mineral fertilizers by more efficient collection and application of manure.
- Increase in soil organic matter, thereby fixing carbon and other nutrients in the soil.
- Planting of permanent crops and hedgerows along plots. More generally, the protection and reforestation of forests must have highest priority for mitigating global warming.
- Installing biogas fermenters could be a means to reduce GHG emissions, as methane would be partially replaced by carbon dioxide, which is a less potent GHG.

Fig. 47. Emitting methane could be collected and used for heating or cooling.

4.2.6 Biodiversity & Plant protection

Rationale: The diversity of organisms and the health of ecosystems are closely tied with each other. Through the regulation of water, nutrient and gas balances, pollination, soil formation and other functions, diverse ecosystems render agricultural production and human existence possible.
This indicator rates:

- How diversity at the species and genome level is fostered on the agricultural area
- How well natural ecosystems are preserved and interlinked within the agricultural landscape
- The quality of plant protection management on the farm
- Whether plant protection products are persistent or toxic to environment and non-target organisms.

Tab. 11. Biodiversity & Plant protection: Indicator and parameter values as well as the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Biodiversity & Plant protection	**Points**	**42**		**28**		**38**	**36**
Plant protection management	**Points**	**68**		**33**		**13**	**38**
Crop rotation design regarding pest pressure	Points	*50*		*50*		*0*	*33*
Selection of varieties with resistances	Points	*0*		*50*		*0*	*17*
Consideration of damage thresholds or other expert systems	Points	*100*		*50*		*0*	*50*
Determination of pests before treatments	Points	*100*		*100*		*100*	*100*
Problems with resistances of pests against plant protection products	Points	*100*		*100*		*100*	*100*
Fulfilling national and international regulations when planting GMO	Points	*100*		*100*		*100*	*100*
Participation in biodiversity programs	Points	*0*		*0*		*0*	*0*
Toxicity of Plant Protection Products PPP (Average)	Points	*25*		*45*		*29*	*33*
Persistency of PPP (Average)	Points	*100*		*65*		*71*	*78*
Ecological priority areas	**Points**	**41**	**100**	**29**	**0**	**71**	**48**
Landscape quality	**Points**	**52**		**10**		**50**	**37**
Points for the degree of landscape structures	Points	*12*		*10*		*50*	*24*
Intensity of agricultural production	**Points**	**15**		**36**		**12**	**21**
Intensity of fertilization	Points	6		24		25	18
Stocking density of animal husbandry	Points	0		46		0	15
Intensity of PPP use	Points	40		50		0	30
Biodiversity promoting measures	Points	13		25		23	20
Biodiversity promoting measures on arable crops	*Points*	*13*		*25*		*19*	*19*
Biodiversity promoting measures in permanent crops and forest	*Points*					*50*	*50*
Diversity of agricultural production	**Points**	**34**	**6**	**30**	**6**	**46**	**24**
Valuation number of land-use types	Points	*20*		*60*		*60*	*47*
Valuation number of species in production systems (100 pts. when 6 and more species)	Points	*67*		*100*		*100*	*89*
Number of old and rare varieties on farm	Points	*0*		*0*		*100*	*33*
Valuation number of different animals and breeds	Points	*17*	*17*	*17*	*17*	*17*	*17*
Number of old or rare breeds on farm	Points	*0*	*0*	*0*	*0*	*0*	*0*
Bee keeping	Points	*100*	*0*	*0*	*0*	*0*	*20*

Plant protection management

For the three farms, the parameters within Plant protection management were rated both in the green but also in the red zone. Topics requiring further attention were the toxicity of used plant protection products (herbicides and insecticides) and integrated pest management.
Farmers partly used highly toxic products (Tab. 12)[1]. Products of concern were those containing for example Paraquat, Diazinon, or Deltamethrin.

- It is recommended to thoroughly reconsider the use of pesticides, with the help of local extension service and to replace critical products by less toxic alternatives. Also the practises of chemical treatments of the whole agricultural area without prior assessment of the necessity is not sustainable.

Further critical points that need further consideration were:

- Application of antibiotics against fire blight in pome orchards. There is need for strict resistance management, to prevent the development of resistances. Farmers should be advised in alternative practices, like planting less susceptible varieties.
- Is burning the alfalfa field best practice for controlling the alfalfa weevil? It should be explored, whether there are better ways to control the alfalfa weevil.
- There is high potential of controlling some of the pests and weeds with appropriate crop rotation. None of the farmers adjusted the rotation with this respect. Accordingly, large areas were cropped by the same crop.

Tab. 12. Applied plant protection products and their toxicity and persistence. Colour code at Treated areas reflects the magnitude of treated area.

	Type	Acute toxicity	Chronic toxicity	Toxicity for non-target and beneficial organisms	Persistency	Treated area	Comment
Paraquat	Herbicide	High	High	Medium	>3 months	170ha/53ha	Alfalfa
Tribenuron-Methyl		Medium	Medium	Low	<1 month	220ha	Barley, wheat
Foramsulfuron; Isoxadi-fen-ethyl		Low	Low	High	>3 months	160ha	Maize
Clodinafop-propargyl, Cloquintocetmexyl		Low	Low	Low	<1 month	140ha	Wheat
2,4-D Sel amine		High	Medium	Medium	<1 month	45ha/81ha	-
Haloxyfop-R		Low	Low	Low	1-3 months	75ha	Canola, Alfalfa
Imazethapyr		Medium	Medium	Medium	<1 month	55ha	Alfalfa
Clodinafop-propargyl, Cloquintocetmexyl		Low	Low	Low	<1 month	36ha	Wheat
Glyphosate		Medium	Low	Medium	1-3 months	3ha	Along channels
Chlorpyrifos	Insecticide	Medium	Medium	High	1-3 months	110ha	Alfalfa, garden
Diazinon		Medium	Medium	High	1-3 months	100ha	Alfalfa, garden
Deltamethrin		High	High	High	<1 month	45ha	2x all crops without garden
Imidacloprid		Medium	Low	High	<1 month	-	Pistacia/canola

1. Toxicity levels according to Kegley, S.E., Hill, B.R., Orme S., Choi A.H., *PAN Pesticide Database,* Pesticide Action Network, North America (Oakland, CA, *2014), http://www.pesticideinfo.org. and IUPAC (http://sitem.herts.ac.uk/aeru/*iupac/atoz.htm)

Ecological priority areas and Landscape quality

Many plant and animal species require ecologically valuable, structurally diverse and near-natural habitats for their survival. The extreme changes that have affected cultural landscapes in recent decades, in particular the intensification of production practices have reduced species diversity. Biodiversity can survive in protected areas, but given the large proportion of agriculturally used surfaces in many landscapes, the preservation of extensive production practices is important as well.

Some landscapes of the analysed farms were structured with trees and hedgerows along the plots (Fig. 48), other landscapes were completely cleared without any structures (Fig. 49). The share of such ecologically valuable zones[1] ranged from 5 to 12% of total agricultural area. There were farmers recognizing the value of trees and they planted trees along field edges and roadsides. These linear structures have multiple positive effects on both, the local ecosystems and climate. They offer for example habitat for Iranian fauna, like the birds of prey like harriers, and hawks, helping buffering the effects of large monocultures (e.g. mice problems). Moreover, they cool down and moisten the soil and local climate. They are effective windbreaks; hedgerows can reduce wind speed for a distance 5 to 7 times of its height (Kourk, 2000). The necessity of such measures was obvious on farms in the dryer zones of Qazvin province where progressive desertification was already obvious. But also from the financial point of view investments in timber and fruit trees can be profitable and can be regarded as a form of long term saving.

- It is recommended to plant trees along some of the field plots. Farm managers should further be sensitized of the value of wild biodiversity that stabilize agroecosystems. We suggest to establish small reserves as living habitat for wildlife (birds, insects, etc.).

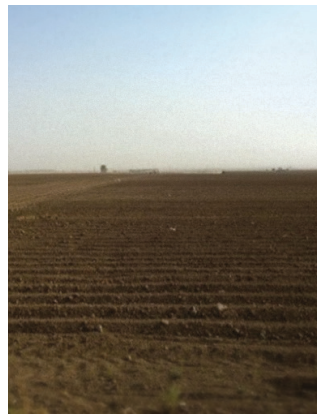


Fig. 48, 49. There were both richly structured landscapes but also completely cleared landscapes without any value for biodiversity

Diversity of dairy and agricultural production

This RISE parameter measures the contribution of the farm to on-farm conservation of agrobiodiversity. On-farm conservation is an important contribution to the protection of genetic resources and at the same time, can serve the protection, management, and development of valuable cultural landscapes. Genetically diverse crops can also contribute to greater stability of production, as disease and insects can spread more easily when the host plants (or animals) are more genetically uniform. In the analysed crop production systems, the diversity of production systems was simplified. Crop rotations contained mostly wheat, barley, maize for silage and alfalfa. The disadvantages of low crop diversity are problems with soil fertility, pests and weeds due to mono-cropping. This can also lead to low product prices, because of overproduction of particular crops. According to the extension service of the local agricultural administration, there would be several crops suitable to improve and enrich the rotation like sainfoin, clovers, vetches, sorghum and others. For maintaining soil fertility in the long term, the extension service also advices to alternatively keep some parts of the productive area as fallow. Not only from the agro-biodiversity point of view, it is desirable to extend the range of cultivated crops (and varieties), also from the financial perspective it may be advisable to spread potential risks (see Economic viability; Economic vulnerability).

- It is recommended to present farm managers alternative crops and to instruct them in cropping these new crops and provide support in marketing.
  One farmer specialized in gardening. The diversity in this garden was high and should be maintained. It allowed to produce a broad variety of high value fruits and vegetables.
- Animal production is also very simplified and concentrates on the dairy breed Holstein. It is recommended to explore additional breeds better adjusted to the hot and dry climate. The introduction of dual-purpose breeds (like Simmental or Swiss Brown) could also be one more option.
- They have slightly lower milk yields, but such breeds are oriented not only to a high and economic production of milk but also of top-quality meat. If there is interest to explore alternative breeds, it is recommended to start a small herd with an alternative breed in order to gain experience.

1. Wild and domestic trees, hedges, abandoned places, bushes, shrubs and similar structures were considered as valuable for biodiversity.

Intensity of agricultural production

The intensity of agricultural production strongly affects species diversity (Donald et al., 2001; Marshall et al., 2003; Green et al., 2005; Kleijn et al., 2009) as well as ecosystem functions such as biological pest control (Tscharntke et al., 2005; Geiger et al., 2010), crop pollination (Biesmeijer et al., 2006) and the conservation of soil fertility (Brussaard et al., 1997). Broadly speaking, less intensive production systems can better contribute to biodiversity conservation.
Rating for intensity of production, reflected by the number of animals per hectare (stocking density) and accruing nutrients from livestock production (fertilization intensity), were both high. As discussed with the Water use indicator, nutrient emissions to the environment were a severe threat to aquatic ecosystems.
Intensity of PPP use was medium to high with 1.5 – 3.1 times of total area. A goal of the management should be to keep the amount of used PPP and the number of treatments as low as possible, by exploiting the full potential of integrated pest management.

4.2.7 Working conditions

Rationale: A healthy and motivated labour force is a basic requirement for the success of an agricultural operation. These traits are decisively influenced by on-farm working conditions.
Working conditions for farm employees and self-employed farm labour are estimated in RISE 2.0 by measuring the following aspects: organizational health and safety, work organization, respect of human rights, remuneration and fairness/justice.

Working conditions were in the yellow zone in the RISE analysis (Tab. 13).

Tab. 13. Working conditions: Indicator and parameter values as well as the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Working conditions	**Points**	**55**	**69**	**59**	**62**	**44**	**58**
Personnel management	**Points**	93	100	97	87	80	91
Driving forces on motivation	Points	*100*	*100*	*100*	*0*	*100*	*80*
Equality (gender)	Points	*100*	*100*	*100*	*100*	*100*	*100*
Equality (other characteristics)	Points	*100*	*100*	*100*	*100*	*100*	*100*
Forced labor	Points	*100*	*100*	*100*	*100*	*100*	*100*
Working times	**Points**	47	28	62	52	15	41
Working time (employees)	Points	*47*	*28*	*62*	*52*	*15*	*41*
Working hours per week (employees)	Points	*24*	*11*	*30*	*34*	*22*	*24*
Working days per week (employees)	Points	*5*	*0*	*40*	*33*	*22*	*20*
Holidays and high days (employees)	Points	*58*	*0*	*78*	*39*	*15*	*38*
Working time (self-employed)	Points	*47*					*47*
Working hours per week (self-employed)	Points	*84*					*84*
Working days per week (self-employed)	Points	*0*					*0*
Holidays and high days (self-employed)	Points	*56*					*56*
Safety at work	**Points**	61	92	57	75	52	67
Incidences (accidents and diseases)	Points	*100*	*100*	*100*	*100*	*99*	*100*
Quality work safety (safety concepts)	Points	*0*	*100*	*0*	*0*	*0*	*20*

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Example of a safety risk: plant protection products and animal treatment products	Points	*45*	*68*	*27*	*100*	*9*	*50*
Toxicity of plant protection and animal treatment products	Points	*0*	*50*	*0*		*0*	*13*
Quality of application and storage of products	Points	*100*	*100*	*60*		*20*	*70*
Child welfare	Points	*100*	*100*	*100*	*100*	*100*	*100*
Salaries and income level	**Points**	18	56	20	33	27	31
Attractiveness of salaries (employees)	Points	*20*	*56*	*20*	*33*	*27*	*31*
Attractiveness of household consumption (self-employed)	Points	*15*					*15*

Personnel management

Personnel management was generally good at the assessed farms. For example, short- and mid-term personnel needs were known, and replacements were planned in due time. Most workers had written working contracts and got payslips. Personnel were mostly people from neighbouring villages. There were no signs of discrimination, neither based on gender nor based on other traits. However, in the domain of motivation of the workers there were observations indicating a certain backlog at the farms:

- There were reports that certain workers only deliver good performance when top management was present at the farm. This is an indication for poor identification with the company and maybe weak leadership of middle management.
- Management tried to prevent lazy or improper behaviour by installing cameras for controlling the workers. This may have led to a relation based on mistrust and control between management and workers, again corrupting intrinsic motivation.
- Workers on most farms complained that there were no incentives to deliver a good job. Reason may be not enough personnel for middle management.

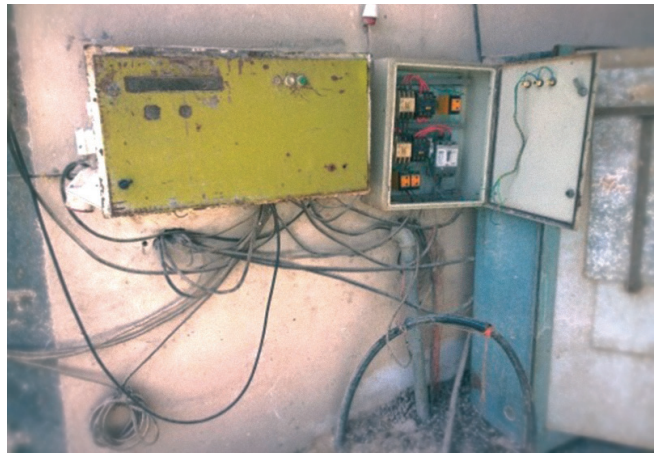


Fig. 50. Poorly maintained and unsecured electrical devices

Safety at work

Despite the large size of the farms, none of them had a safety concept. Safety concepts ask for a systematic assessment of safety risks, the development of farm-tailored solutions, and the provision of guidance in implementing the measures. Effective safety concepts are important for good business reputation and prevent accidents and diseases, which, over the long-term, also saves money. Fortunately, in the last years only few and not serious accidents occurred on the visited farms. Nonetheless, according to our observations, the work places were not free of risks. For example electrical devices were poorly

Fig. 51, 52. Unsecured pits and holes impose a threat for people and livestock at the farms

Fig. 53. Feed factories are dusty environments, they can harm the respiratory tract of the exposed workers when not properly protected.

Fig. 54. Workers applying chemicals should wear protective equipment like boots, gloves, and masks.

maintained and secured, thus live parts were accessible (Fig. 50). Another frequently observed problem was unsecured tanks, manure pits and sewage basins (Fig. 51, 52). Persons falling in such pits could not escape by their own and could quickly drown. Such places have to be effectively secured. Some work places were extremely dusty like the feed factory (Fig. 53). Workers not applying appropriate protective masks risk harming their lungs with the dust.
According to the management, chemicals were stored and handled professionally (e.g. storage in a locked room, usage by trained persons and with protective gear only). Nevertheless, persons were observed applying pesticides without sufficient protective gear (Fig. 54). Workers should be instructed to wear appropriate protection.

- It is recommended to screen the farms for hazardous places and harmful practices and to develop an action plan how to tackle the identified issues.

Working Time and Salary level

Working Time parameter scored medium to negative at the farms. Workers frequently did not take days-off, usually working full weeks. On some farms they also did not take any holiday leave. Viewed superficially, farm management makes a favour to the workers to let them work as much as possible. Workers voluntarily work that much and they are paid for overtime. However, the reason why workers do not take recovery time is the low level of salaries and the lack of alternative jobs. Paid salaries were not sufficient to allow a good life for a small family with two adults and two children. This critical level was set together with the local expert team to 297,383,648 IRR per year.
From a health point of view, recreation is very important for the well-being of the workers. Furthermore, permanently working people are not as productive as recovered people. The combination of low salaries and long working hours can negatively affect the motivation of workers. A significant reason for the low salaries is the fact that due to economic situation in the region with high unemployment rate, workers are in a weak position when it comes to negotiating their salaries. The right of collective bargaining are important instruments for safeguarding the personnel's rights. It is claimed by the core conventions of ILO and considered by various other international standards in the food sector. For the farms, it is important that their employees and members can freely express their expectations, and that these demands are incorporated in the farm and personnel management.

- It is recommended, when the economic situation of the farm allows, to pay salaries at a level that allow the employees to take recreational leave and weekly day off. Paying salaries above regional average could attract the most competent and motivated people from the region, compensating for the higher personnel costs.

4.2.8 Quality of life

Rationale: A high level of satisfaction with work and life in general is important for the physical, mental and social health of people living on the farm. Quality of life, satisfaction and happiness are important indicators for the success of sustainable development. Quality of life stems from the fulfilment of individual goals within current objectives.

Tab. 14. Quality of life: Indicator and parameter values and the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Quality of life	Points	76	73	73	62	69	71
Occupation & Education	Points	75	67	83	67	50	68
Financial situation	Points	75	75	50	50	75	65
Social relations	Points	100	100	88	63	88	88
Personal freedom & Values	Points	67	33	58	42	58	52
Health	Points	63	88	88	88	75	80

In general, the interviewed persons were satisfied with their lives. The rating regarding the different working areas was individual from person to person. Most positive ratings were given for social aspects related to friends, neighbours and community, and at cultural and spiritual aspects.
In the domain of Occupation & Education they appreciated their good school education. They were happy to have a job at the farms (Fig. 55) and some appreciated the good atmosphere. They also excused that there was some delay in payments. As salaries were comparable to other jobs, they arranged themselves with the low level of salary.
Income situation and standard of living was generally rated as medium, indicating tense financial situation. As mentioned in the Working condition section, workers complained about limited development opportunities in their job and monotonous work. Workers were mainly trained on job and they could not acquire new skills, allowing them e.g. to take more responsibility or do other duties. All of them mentioned that they would appreciate to get more trainings and formal education. The daily routine and stressful work was also mentioned by the management level of the farms.

- **Better work organisation possible, and improved distribution of work?**
  Medium to negative ratings were given to the current framework conditions. People were affected by the difficult economic situation with low availability of good jobs. They were scared about the insufficient health care system in the region with shortages of drugs and emergency services.

However, most people felt safe and comfortable. But some had to live in quarters with bad neighbourhood.
Farm managers complained about the low official milk price that would not allow them to sufficiently maintain the farm.

- It is recommended to train people in different types of work. Periodical rotation of work could increase the attractiveness of the job. It could also advance the quality of the work as the workers would gain a better understanding of the overall tasks and final products.

Fig. 55. The housings for the workers at the visited farms were at a good level.

4.2.9 Economic viability

Rationale: The achievement of economic viability is central to the agricultural enterprise, but has to respect social and environmental boundaries. Business responsibility entails long-term profit generation, and the constant maintenance of sufficient liquidity and stability.

The results in this section suggest that the Economic viability of the studied farms varied considerably between the analysed parameters (Tab. 15).

Tab. 15. Economic viability: Indicator and parameter values and the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Economic viability	**Points**	**48**		**57**	**18**	**61**	**33**
Liquidity reserve	**Points**	**0**	**2**	**4**	**15**	**3**	**5**
Liquidity reserve (weeks): Liquid assets / Average weekly expenditures	Weeks	0	0.8	1.6	6.6	1.3	2.06
Cash flow - turnover ratio	**Points**	**44**		**53**	**10**	**67**	**44**
Ratio: Cash flow operational / Business volume	%	6.6		7.9	1.5	9.9	6.4
Level of indebtedness	**Points**	**90**		**96**	**0**	**99**	**77**
Ratio: (Borrowed capital - Liquid assets) / Cash flow operational	Years	1.5		0.6	42	0.2	9
Debt service coverage ratio	**Points**	**79**		**72**	**0**	**98**	**62**
Ratio: Debt service / (Cash flow operational + Interests)	%	32		42	266	3	86
Economic vulnerability	**Points**	**60**	**69**	**62**	**66**	**36**	**59**
Share of the most important income source on total business value	%	99	100	85	98	90	94
Evaluation: Share of the most important income source on total business value (bulk risk)	Points	*1*	*0*	*15*	*2*	*10*	*6*
Evaluation of infrastructure, market situation and income security	Points	*80*	*92*	*78*	*88*	*44*	*76*
Risk evaluation for governmental support	Points			*11*	*44*		*28*
Livelihood security	**Points**	**15**					**15**

Liquidity

The farm managers mentioned in the interview that all were confronted with acute liquidity problems as the liquid means were limited in comparison to the running costs of the farming enterprise. Farm managers would only be able to cover the costs for about 2 weeks with the available financial resources. While dairy farming should guarantee regular income every month, a temporary loss of income can never be excluded. Without alternative income sources or savings, their operations would be jeopardized from bankruptcy. Liquidity data have to be interpreted with caution as most farms were organized as a holding company. Within these structures there may be certain financial reserves ensuring financial security and liquidity. For financial managers of the farms, it is recommended to verify the broad picture of the liquidity situation, to ensure continuous liquidity.

Cash flow - turnover ratio

The cash flow measures the financial strength of the operation. It shows the farm's ability to generate own resources for investments, dividend payments, debt payments and to increase liquidity without the use of borrowed funds. All farms analysed reached a positive operating cash flow, which means, that income from selling products were higher than the costs (Tab. 15). Optimally, farms generate a Cash flow of 20% compared to the total turnover. The analysed farms lied between 1.5% to 10%, rating from critical to positive. It appeared that farms with recent high investments had more problems to be sufficiently profitable.

Level of indebtedness and Debt service coverage ratio

With one exception the level of indebtedness was low at the farms. This means that with current cash flow farms could repay the remaining debts within short time, which is beneficial to stay independent from capital lenders.
Similarly, regarding the Debt service coverage ratio, these farms with low debts could easily pay debt services with the current cash flow, indicating good financial standing. For the farm with the highest investments, the rating was in the red zone, indicating critical level of debt service compared to the current cash flow. Within healthy holding structures high liabilities may be financeable for some time, but need high attention.

Economic vulnerability

For all farms, dairy production was by far the most important farm branch. Even at farms with crops, sales of animal products reached between 85% and 99% compared to sales from crop production. Nonetheless, the advantage of mixed farms was their ability to produce own feed thereby reducing their dependency on external fodder supply and reducing their fodder costs. In case of potential market instabilities, mixed farms are expected to be less vulnerable to fodder shortages or increasing fodder costs, than the pure dairy farms.
The bulk-risk from dairy production was even aggravated as the selected breed is only strong in milk production but weak in meat production. Dual use breeds like Simmental or Brown Swiss could considerably strengthen the income from meat production.

- It is therefore recommended to evaluate alternative breeds (as discussed above)

Beside the evaluation of bulk-risks the condition of infrastructure was another criterion. It showed that particularly older farms were weaker in this respect and would require higher investments in maintenance than the newer one. Maintenance backlogs can only be tolerated for a short period. Cascading damages from bad maintenance could raise the costs disproportionally.

- It is recommended to continuously invest in the maintenance and modernization of infrastructure.

Farm managers evaluated the market developments for their products positively.

- However, it is recommended to work on scenarios to reduce costs and increase incomes, as well as to evaluate the optimal mix between specialization and diversification.

It is important to note that some farms were organized as holdings. Hence this sustainability analysis only considered one branch of the holdings. It is therefore possible, that diversification at the holding level was better than at the farm level.

Livelihood security

One farm was organised by several owner-families, all working at the farm. The reported financial withdrawal of the owner families was rated to be low. This indicates modest live style of the farm owners' households or perhaps even lack of financial resources to cover their livelihood expenses.

4.2.10 Farm management

Rationale: Sustainable farm management is the steering of operations with the primary objective of high competitiveness on all relevant markets, as a prerequisite for the continuation of the business. This is to be obtained by an environmentally and socially appropriate employment of material, human and capital resources.
This indicator measures the existence and quality of purposeful, long-term and holistically aligned farm management.

The RISE scores for the overall Farm Management indicator were in the yellow and green range on all farms (Tab. 16).

Tab. 16. Farm management: Indicator and parameter values and the average of the five farms analysed with RISE in Qazvin province, 2015.

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Farm management	**Points**	**71**	**69**	**63**	**65**	**52**	**64**
Farm strategy and planning	**Points**	63	100	75	88	63	78
Planning instruments and documentation	**Points**	68	83	82	85	49	73
Personnel management: planning instruments and documentation	Points	*100*	*100*	*100*	*90*	*80*	*94*

Name	Unit	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Avg
Production: planning instruments and documentation	Points	*42*	*67*	*58*	*33*	*13*	*43*
Supply and yield security	**Points**	100	86	100	100	100	97
Quality management	**Points**	50	75	50	50	50	55
Quality work safety (safety concepts)	Points	*0*	*100*	*0*	*0*	*0*	*20*
Quality waste management	Points	*0*	*0*	*0*	*0*	*0*	*0*
Farm cooperation	**Points**	75	0	8	0	0	17

Farm strategy and planning

None of the management strategies of the studied farms included clear plans and development strategies for improving all three dimensions of sustainability (social, economy and ecology).

Highest priority was given to the improvement of the economic situation. The common strategy was to expand the farm. The strategy was that more land, more cows and more milk would divide the fixed costs by more produced entities and improve efficiency. Another strategy to increase profitability was to generally optimize processes at the farms, with the aim to reduce costs. Some planned to diversify their business, by processing the raw milk by their own.

Some measures were reported with positive side-effects on the ecological dimension. One farmer mentioned to expand the number of trees as they would be profitable and would need less water. This would lead to a win-win situation for both ecology and economy. There were also several investments planned or underway in sewage systems and waste water treatments for reusing water and reduce water consumption. Other invested in manure separation, manure flushing systems or planned to reduce chemical use with ozone treatments in order to reduce environmental impact.

In the social dimension the development strategies were mostly much less prominent. Some mentioned that they built rooms for the work breaks, they would provide small loans at low rates for staff or they planned to reduce the workload of the workers as soon as there would be sufficient profit. Others wanted to invest in sport facilities or holiday homes for meritorious workers and management staff.

The steering of large farms is challenging. Inconsistences in planning and communication have immediate impact on the farm performance. This also includes the challenge that enough qualified and skilled workers at all levels were available. Furthermore, the management of large herds is challenging and also requires enough skilled people at all levels.

- It is recommended to critically review and improve both, organizational and work processes. Good workers should actively be involved in the farm management process and rewarded for substantial contributions. Furthermore, it is recommended to identify knowledge gaps and to search for internal (training, further educations) and external (consultants) solutions, to advance farm management skills.

Planning instruments and documentation

The studied farms were generally good with regard to planning instruments and documentation. However, at one farm workers did not get payroll slips.

- It is recommended to establish such systems.

Supply and yield security

Farm managers said that they were not confronted with events or shortages threatening the existence of the farms. One farm reported a significant loss, when there was a fire in an alfalfa stock. As there were no insurances the loss had to be covered by the owners. Beside this obvious observation, farm managers generally believed that possible risks would be sufficiently insured.

- However, for the farms the concentration on one main product (dairy) imposes a bulk risk. Livestock diseases are a major threat for the farms and ensuring health of animals should get highest priority.

It is also recommended to strictly take all required hygienic precaution measures and to reduce livestock exchange between different farms to a minimum.

Quality management

Opportunities for improvement were identified in the quality management parameter, due to a general lack of safety concepts, partly problematic waste disposals. Whereas the product quality of the milk was ensured by regular checks when delivering the milk.

Farm cooperation

The analysed farms usually did not cooperate with other farms; neither in selling, buying, marketing nor in sharing machinery, infrastructure, or workers (e.g. specialists). It seemed that the large farms were large enough to get advantageous offers or that machinery and infrastructure were sufficiently utilized.

- It is still recommended to explore opportunities for cooperation. For example to advance the diversification goal, by cooperating with farmers who could develop the crop, tree and most importantly for the dairy farms - fodder production.

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Acknowledgement

I would like to thank Dr. Niaz Ali Ebrahimi Pak (Former Head of Jihad-Agricultural Organization of Qazvin Province), Mr. Mottaghi (Head of Jihad-Agricultural Organization of Qazvin Province), Dr. Seyyed Bahman Naghibi (Director General of Qazvin Province, Veterinary Directorate), Mr Giuseppe Carella (Nestlé Iran Country Manager), Mr. Faisal Haroon (Factory Manager, Nestlé Iran), Mr. Alireza Mansouri Hamlabadi (Local Sourcing Coordinator) for the Perfect and flexible organization of the RISE assessments. Thanks also Ms. Ghazal Nemati and Mr. Pejman Atrian (Agricultural Service Specialists, Nestlé Iran), Mr. Faramarz Bahrami (QA Supervisor of Nestlé Iran) and the rest of the team for their interest in the topic of sustainable agriculture and their great support. The participating farmers I thank for their collaboration, openness and confidence. I'm also grateful to my colleagues Dr. Samuel Kohler (Veterinary), Dr. Michael Studer (Specialist In Agricultural Engineering), Dr. Christoph Studer (Irrigation Specialist) and Thomas Kupper (Manure Management Specialist) and the rest of the members at HAFL for their backstopping and valuable discussions of the results.
Many thanks to Firesenai Sereke for his great effort and critical review of the text and for his valuable comments.

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Annex 1:

RISE, a project report, 2016

It was in 2001, 15 years ago, that Nestlé, the world's largest food & nutrition company, with 150 years of experience and a portfolio of over 10,000 brands, began their operations in the Islamic Republic of Iran, producing NESTLÉ NAN infant formula and CERELAC. Nestlé Iran has continued to invest into its operations since then, and currently produces NESCAFE and NESQUIK in its award winning factory located in Qazvin, however infant formula continues to be considered as the most important products produced locally. The country's demand for infant formula had previously been supplied though importation, and Nestlé had decided 15 years ago to begin local production of this primary substance, using domestic raw materials and reducing importation. The initial steps required for national production of this primary substance were to find qualified farms that would meet the required standards of milk quality required to obtain infant milk production qualification ratings.

"Nestlé Iran's Agriculture Services Department" started its activities in 2015 and in June 2015, invited Christian [SURNAME], an Assessment Officer from Switzerland's Bern University, to begin a week long assessment of the newly named project RISE in cooperation with the Iran Vetinary Organisation and the Qazvin Province Agricultural Jahad Organization. As described in the details of the final assessment report, five major dairy farms in the Qazvin province were studied. Since dairy farms in Iran use mainly industrial husbandry systems and are known as "Mega farms", the assessment of infrastructures declared that the required conditions for creating model farms exist. Therefore "Nestlé Group" decided to choose a farm that has the capabilities to serve as a role model. Consequently, two Nestlé supplier farms were chosen and since last year, through the successful execution of this project and holding continuous meetings with these farms, the continuous progress and enhancement of the operation of these farms were set as the target. The RISE project identified 10 major criteria to assess and improve upon, including:

- Soil management
- Water consumption
- Energy consumption
- Livestock husbandry
- Nutrient cycle
- Biodiversity
- Labour conditions
- Staff welfare
- Farm economic condition
- Farm management

Without the tireless activities of Nestlé and the mutual cooperation between this company and the raw milk supply farms, the continued progress and successful sustainability of these farms would not have been possible.

Below are the activities taken in these 10 criteria:

1. Animal husbandry

Five major criteria have been analysed for this purpose, namely:

- Cattle management
- Livestock products
- Animal behaviour
- Stall quality
- Livestock health

Cattle management, livestock health, and product collaboration between the Nestlé Group and the farms led to an increase of milk quality and cattle health. As a first step, analysis of the livestock health was the priority, and since activating in 2015, the Nestlé Agriculture Services Group has continuously assessed and visited the two selected farms. After the samplings, it was determined that these farms had low quality levels regarding aflatoxins, antibiotics, milk somatic cells, and TPC.

Controlling Aflatoxin levels in feed and milk

Aflatoxins are poisonous fungi which become poisonous through the consumption of feed contaminated with fungi, and will result in the poisoning of the milk produced. The consumption of Aflatoxin contaminated feeds can increase the level of existing aflatoxin in the milk, on the other hand, the increase in the aflatoxin level of cow milk may lead to abortion, sterility, liver failure, and some metabolic disorders. Therefore, controlling the level of this poison in the feed will provide more comfort for the animal, which at first guarantees the livestock health but also makes the milk supplied healthier for the consumers. The process of controlling these poisons began with the monitoring of the livestock feed, the most effective factor on the levels of aflatoxin. Preparing necessary SOP-s for feed purchase, feed storage, fodder ensiling, proper washing of feed equipment, preparing TMR (total mixed ration), and presenting them to the management are among the first steps of the control process.

Afterwards continuous training sessions were held by Nestlé experts to teach these standards to the management and the workforce of the farms.

By execution and devotion to the required standards of feed purchase and storage, the farmers were able to purchase high quality feed and store it based on the required protocols. Continuous monitoring of the operation, preparing farm feed, continuous monthly visits from Nestlé experts to both milk supplier farms, feed sampling, and preparation of a list of related duties were the steps preformed next. A full report of these operations was delivered to the farm managers to solve any potential shortcomings.

Afterwards, for the first time in Iran, by the assessment of risks and threats, Nestlé classified each consuming feed livestock based on their risk of contamination, and performed continuous sampling and measuring of aflatoxin level in the feed. Based on the collected results of feeds, standards were defined for the measurements of acceptable AFB1 level in each feed. This standard was defined and executed for the first time in the country. (Diagram 1)

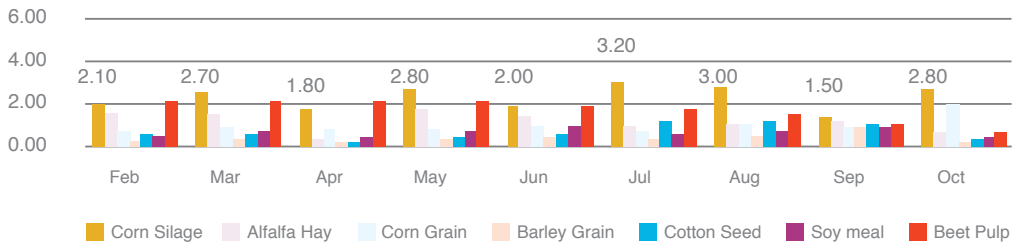

Diagram No. 1. the aflatoxin level of feed (ppb) in 7 major consuming feeds in farm No. 1 during the first 10 months of 2016

Holding manure management seminar in Nestlé Iran, with the big livestocks of the area.

According to the results of feed aflatoxin, the farmers were given consultations to accept or decline the incoming feed. In both of the farms, at first a "Quality Control Committee" (QC) was formed, and the whole feed was first assessed by this committee before entering the farm, and was only allowed to enter the farms after receiving confirmation from the committee. This "Quality Control Committee" performed monthly assessments of the storage procedures, conditions, and other factors, whilst also setting up certain procedures for the washing of storage areas. The flaming of the stalls was another effective method for deduction of aflatoxin level. The quality of incoming feed was influenced indirectly by the contamination decrease resulting from the flaming. Flaming the stalls prevented contamination of stalls and the assembly of mould in the stall corners, ultimately providing more suitable stalls for the herd. Accordingly the necessary protocol and regulations were performed during consumption.

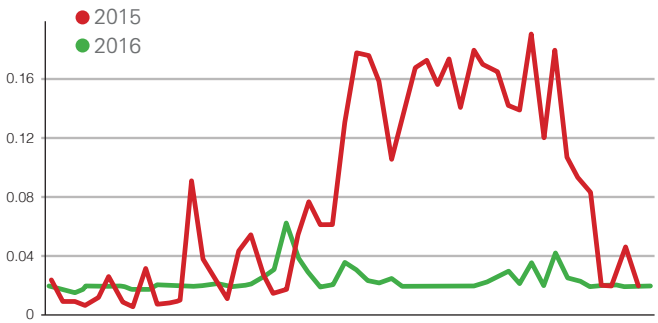

Diagram No. 2. Comparison of milk aflatoxin level in farm No. 1

On the other hand, some infrastructures of the animal husbandry required improvement and renovation. In order to improve the storage condition of feeds, the renovation of structures of the storages and silos was necessary. Therefore, in both of the farms, the old infrastructure that was causing contamination in the feed was renovated. The renovation of bunker silos in order to store silage, renovation of HVAC systems in tower silos in order to store corn and barely, renovation of feed preparation storages and repairing siding walls of both of the farms are examples of the steps taken. These activities resulted in a tangible reduction of milk aflatoxin level in the current year in comparison to the previous year. (Diagram 2)

In addition to increase of milk quality, it should be noted that control in aflatoxin levels indirectly improves the immune system of the animal, prevents metabolic and non-metabolic diseases of the immune system, increases the welfare of livestock, and provides an overall positive impact on them. Furthermore, in addition to


Storing food


Storing food


Improving the corn ensiling method and preparing related standards


Storing food

improved quality, the control of milk aflatoxin levels results in a notable economic benefit return to the society.

In the past, the purchase of livestock feed was performed only based on the cost of feed and its nutritional factors. After the execution of proposed standards, the first step requires that feed is purchased based on quality and contamination level. This is considered as a huge revolution in the cattle husbandry business; historically dairy farms were only producing milk for dairy factories, but today they are capable of producing milk with the strict standards required for infant food.

- Controlling conditions of the livestock's bed to control milk TPC and SCC level

Two other factors that indicate the farm's hygiene are milk TPC and SCC level.

SCC

In this regard, the "Nestlé Agriculture Services Team" and "Quality Control Unit", in cooperation with expert farm veterinary physicians, prepared protocols to enhance bedding conditions, regular programs of SCC monitoring, cattle treatment, and the separation of sick livestock and antibiotic treatment for them. Thus, both the amount of somatic cells and antibiotic treatment are controlled and as described in detail in the Nutrition section, bedding control is analysed by certain protocols for quality, and for repair and renovation. (Diagram No.3)

Regular sampling of cattle milk can distinguish cattle contaminated with high SCC and sick cattle that do not have the obvious clinical symptoms of udder thelitis, and as a result, prevents the disease progressing among the herd. In addition to limiting clinical udder thelitis of the herd, these actions can prevent the spread of contamination via milking machines, and also prevents the increase of TPC in the rest of the herd. The farmers were given necessary protocols and since then, all the cattle were analysed for SCC levels whilst proper treatment stalls were built in the farm hospital area.

TCP

All the actions taken to control the milk TPC level included 3 major criteria:

- Hygienic activities of milking
- Enhancing hygiene while milking
- Cleaning the udder and proper bedding

In order to create proper protocols for milking hygiene, all the procedures and activities performed in the milking halls were analysed, namely CIP, cleaning livestock, and milk transmission lines. Any problems in CIP conditions can transfer microbes to other cattle and can indirectly lead to udder thelitis. Therefore, the controls for milk transmission lines, the temperature of the consumed water, and washing liquids used for CIP were analysed and controlled and in case of any deficiency, the farmer was informed. For all the consumed spare parts in the milking process, an efficient life time was defined based on the standards and the farmers were obliged to replace the parts within certain time

periods, eventually leading to a reduction in different contaminations to livestock. (Diagram No.4, 5)

Udder washing methods via proper and effective materials, before and after milking, can decrease the number of bacteria significantly. These methods can decrease the transmission of pathogens via the milker's hands, reduce secondary contaminations, and eventually will lead to reduction of TPC and CSS level in the milk. Protocols for bedding and its hygiene and revocation by farmers are described in detail in the Husbandry section.

Cleaning milking halls and milk transfer lines

Controlling Antibiotic Levels in Milk

Another factor that was monitored in milk was antibiotics. Proper usage of antibiotic treatments, proper storage conditions, proper veterinary prescription, storage period, and antibiotic consumption prevention were among the factors analysed. All the protocols to avoid milk contamination by antibiotics were prepared under supervision of the veterinary physicians. According to the related protocols, cattle undergoing treatment were settled in a separated area, their produced milk did not enter the milk production cycle, they were milked in a separated cycle, and the milk was used to feed the calves. The separation of cattle undergoing antibiotic treatment made huge differences in controlling the level of antibiotics found in milk received from these farms. With the execution of this system, it is now possible to track consumed drugs and treated cattle and prevent the spread of the contaminations.

Devotion to these regulations will stimulate proper cattle welfare. In this case the cattle which needed antibiotic treatment were kept in hospital for the required period, they were milked separately and their produced milk was used in separated cycles. Meanwhile, after being separated from healthy cattle, they were given higher welfare standards through receiving more care, and once recovering, they joined the herd and entered the production cycle. By required tracking, cattle under antibiotic treatment were prohibited from entering the production cycle.

In the next step, in order to enhance the tracking quality and ensuring food safety, a laboratory was equipped in both farms and a triennial program was set for them. The farms purchased equipment for analysing the milk of cattle under treatment for this purpose, and before releasing them from the hospital and allowing them to join to the herd, their health condition was diagnosed.

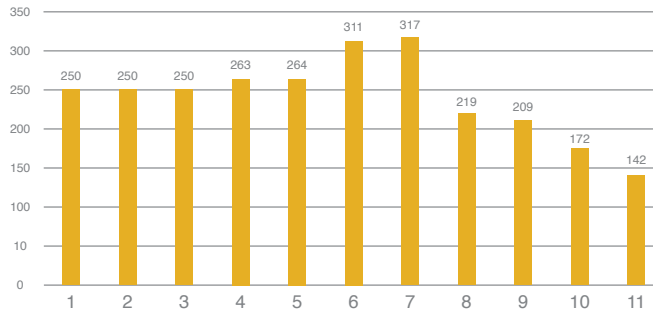

Diagram No. 3. Milk somatic cell conditions in farm No. 2 (in the first 11 months of 2016)

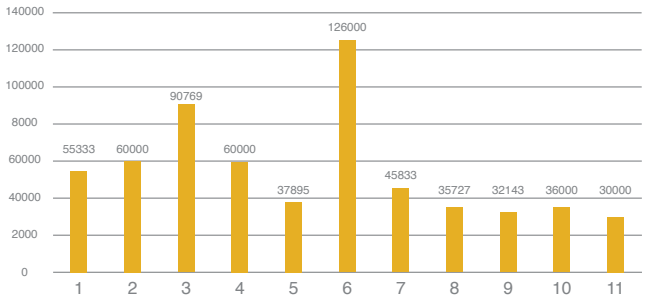

Diagram No. 4. The average of TPC in farm No. 1 (in the first 11 months of 2016)

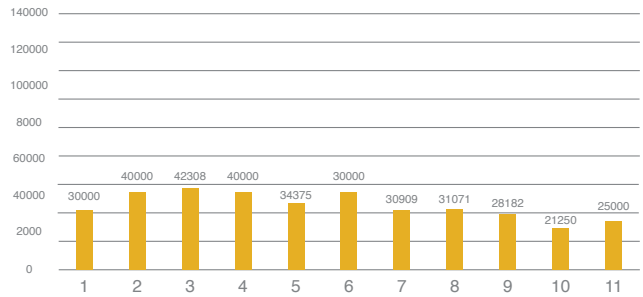

Diagram No. 5. The average of TPC in farm No. 2 (in the first 11 months of 2016)

- **Preventing Entry of Additional Contaminants into the Husbandry Area**

In order to control contamination levels and avoid the transmission of additional contaminants to the cattle, supplementary activities were performed outside of the milking hall. For example non-employees and visitors were prevented from entering the farm and in case of necessity, preventive arrangements were set. The usage instruction of disinfectants in the farm entrance was revised based on updated protocols and the disinfectant soaking baths were equipped with spray systems. Also, in addition to the vehicle wheels that were disinfected in soaking baths, the whole vehicle was sprayed and disinfected before entering to the farm, in order to minimize the risk of any contamination coming in from the outside. Furthermore, the concept of farm zoning was executed and feed and milk carriage vehicles were obliged to move in a certain transport direction.

Preventing entry of the contamination

- Farm Waste Management

Management of waste and liquids in the farm was among the other activities performed to enhance livestock husbandry. As is described in the Nutrition section, corn silo waste water, water wasted in washing progress and the other wasted liquids on farms were separated and managed based on a codified program. The most important problem was the waste water from the corn silos that, in addition to being poisonous, caused malodour, encouraged the assembly of insects, contamination the soil, and was entering underground water sources. Malodour and insects were affecting animal welfare and therefore the management and separation of wastewater, guiding it to wastewater tanks, and its daily evacuation has a positive effect on cattle health.

- Stall quality

Due to the high congestion of livestock and the resulting decrease in animal welfare and life quality, it was vital that stall quality was increased in both farms – specifically where the cattle spend most of their time, the milking hall. Therefore a new milking hall with stalls were built in farm No.1, and a new rotary milking hall (the only rotary milking hall with 82 stall units in the Middle East) was built in farm No. 2. The installation of these systems was the biggest management activity undertaken on these farms and had a significant effect in reducing livestock congestion in the herd. In the past, during warmer seasons, the herd would spend most of its time in milking anterooms with a high ambient temperature.

A seperate place to keep animals that are infected

Managing the waste water and sewage of silos

The biggest rotary milking structure in the Middle East including 82 units

2. Nutrient Cycle & Soil Management

Since waste management was not handled properly in the chosen farms and there were no codified protocols in this regard, all the farms were classified in the RED zone. Furthermore, the gas emission from livestock excreta on the farms led to an increase of the greenhouse effect.

Livestock excreta produced in farms is in two forms; solid and liquid. These two forms go through different directions after being separated by separator machines. The solid is used as livestock bedding and the liquid that caused air pollution, increase of the greenhouse effect, and pollution of underground sources, were stored in coastal lagoons. The first step was to study the disposal map of this waste and t determine its volume and quality. Then in order to manage and control the farm's waste water, both farms separated the 3 different types of waste water (milking, stalls, and silo) produced on farms and stored them separately.

In order to control this issue, both farms invested, built, and equipped waste water treatment systems. It is assumed that by the end of the year 1395, both treatment plants will be put into operation. Therefore, the all waste water from the milking halls will be transferred to these plants to be treated to go back into the consumption cycle.

Protocols are being prepared to properly store solid livestock excreta. The execution of these protocols is explained in the triennial road map provided to the farms, and after the execution, they will not only will have a high impact on avoiding pollution of underground sources and emission of greenhouse gasses on air, but will also control the flies in the farm. Controlling the flies in the farm will have a significant effect on animal welfare in the summer.

Currently, liquid excreta exiting from the separator is considered as a national problem. This waste product is rich in nutrition and is usually wasted on farms, while its non-systematic storage can cause many environmental problems. In order to come up with a national solution, an academically researched, long-term plan is being executed. After numerous meetings with the "Iran Veterinary Organization", the "Agriculture Jahad Organization", and the "Qazvin Province Department of Environment", the plan for using the liquid excreta in agricultural farm is being prepared in cooperation with universities. For the first time in the country and plan is being prepared for the proper and systematic recycling of liquid waste excreta that will be ready and executed over the next three years, with the aim to benefit the region's soil requirements.

Rebuilding new milking machines to increase the milk quality and animals' welfare

Furthermore, waste water from the silos that was returned to the soil and was causing pollution in soil and water sources, is now being stored in tanks.

Regarding soil management, the two factors of soil contamination and soil reaction are important as well. The abuse of mineral fertilizer that can lead to soil contamination with heavy metals, was analysed for this purpose. To enhance this factor, the improvement of soil condition and enriching it with organic farm excreta, in addition to the development of the management system of livestock excreta in the farms, were presented to the "Agriculture Jahad Organization". Using liquid excreta in agricultural farms had a significant positive effect on soil enrichment, prevented contamination with heavy metals caused by the usage of mineral fertilizers, and generally decreased the soil's need for enrichment by mineral fertilizers.

waste water plant

Collecting manure

Managing manure

- Waste Management

For waste management, the 5S training sessions were held in both farms and as a result, the waste management program for both farms were forecasted in the triennial farm road map. In this regards, waste separation was done as an initial step and private organizations were outsourced to collect it from the farms.

3. Economic Survival of the Dairy Farm

All the mentioned principals for purchasing feed and its proper storage, would initially lead to the availability of feed with lower dampness and higher quality, better storage, prevention of food waste and perishability, and ultimately, an increase in feed storage duration. The enhancement of storage and purchasing management systems directly leads to a decrease in the cost of feed. As mentioned previously, purchasing and storage equated to two thirds of the feed processing expenses in the farms. As a result, it can be expected that these activities will have high influence of herd economy.

On the other hand all the actions taken to enhance herd hygiene, which leads to a decrease in milk TPC and somatic cells, have direct relations with herd sickness, treatment, antibiotic consumption, and treatment expenses. Therefore, using enough antibiotics and under recommended conditions, will not only decrease disease, but will also decrease treatment expenses while increasing milk quality. Relying on prevention of diseases and hidden farm problems, preventive farm management can lead to a large decrease in the farms extra expenses.

Through better bedding and the execution of provided protocols, the risk of laminitis occurrence in the form will decrease significantly, and as a result will lead to a decrease in drug consumption, treatment expenses, and culling rate. The farms culling rate was one of the analysed factors in this respect. The related diagram was also monitored in monthly meetings and the results showed improvement in the farms.

Performing all the above activities and preparing related instructions, will lead to producing standard and high quality milk. Also referring to the dairy industry policies in Iran, the ranchers can receive bonuses for producing higher quality milk, which will lead to increase in the net profit of the farms.

Start of the Manure management project in agricultural farms

4. Water Management

Considering the low level of water sources and the fact that 90% of the country's consumed water is in the agricultural industry, it is necessary to have vast projects to control and reduce water consumption in the agriculture section. Since there is no equipment to accurately measure the farms' water consumption, monitoring water consumption must be considered in these centres. The first step in this saving was to analyse and assess the amount of consumed water in the farms. In this regard, quantities such as water consumption levels in each farm and its subsidiaries per certain unit of milk production is of high importance. In this way, the farmers were able to identify the most water consuming section of the farm and plan a road map for reducing the water consumption in these areas in the long term. This monitoring began about six months ago in both farms.

Using liquid manure in agricultural farming

Saving water by transfering rain water by pipes

Spray system

The next step was to assess the water quality in both farms. Therefore, a six month regular program was planned to assess the water quality in both farms. After that, Nestlé expert, Carlo Galli, was invited to Iran to hold water training sessions in factories, farms, and governmental organizations. In this training session, methods of using water monitoring equipment were taught in the farms, and then milk supplier farms used by Nestlé were assessed for risk, water usage, and available source quality. Based on results, a triennial plan was prepared to enhance farm conditions in respect of water consumption recognition, control, and monitoring which were inserted in the triennial road map of the farms. Also a training session was held for the farm managers, to teach the monitoring systems of the water level of wells and their measuring method in the Nestlé factory by exemplifying of this system. Meanwhile, the main water consuming sections, the sprays used in hot seasons, were replaced by low water consumption models aiming at better and more optimized ventilation.

As a result of strong design systems, a plan for the collection of rain water from all freestyle roofs and storage units was executed in one of the farms aiming at optimizing water consumption.

This water is transferred to water storage wells via separated piping systems. (Diagram No. 6)

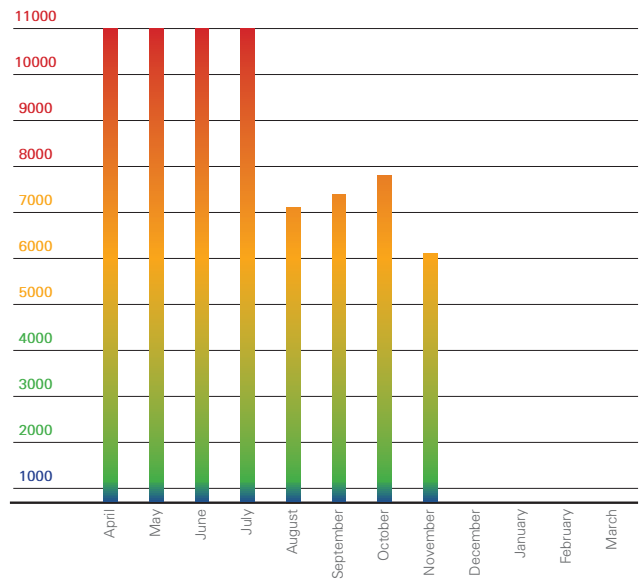

Diagram No. 6. Monthly amount of water consumption in farms

Installing tools for farm's water consumption monitoring

5. Energy Consumption on the Farms

In the RISE project frame, Nestlé suggested the use of renewable energy sources instead of fossil fuels to increase farm sustainability. All the examined farms were classified in the RED zone in respect of energy control and consumption. However, due to the country's condition and fuel expenses in all industries, there were no regular programs to monitor energy consumption. Therefore, this issue was a priority in the farm pentennial road map and the study to enhance this parameter was analysed as a long term plan for both farms. As part of this development plan, regular lamps were replaced with LED lamps in one of the Nestlé supplier dairy farms, and both farms started energy consumption monitoring in 2016. (Diagram No. 7)

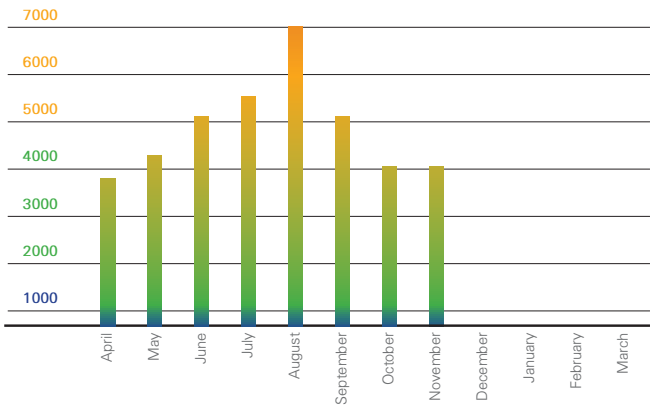

Diagram No. 7. Monthly amount of electricity consumption in farms

Installing LED lamps instead of high consuming lamps

6. Labour Conditions & Staff Welfare

The labour conditions in farms can include a vast scope. Among all labour conditions the workers' job was not interesting and on the other hand, safety points were not considered. In order to increase the interest of the jobs and activities, it was decided to increase the human resources knowledge by providing them proper training and since Nestlé believes that the most valuable asset of an organization is its human resources, developing the staffs' knowledge was a priority and Nestlé started investment on it.

At the beginning Nestlé SHE experts analysed the whole farm, assessed the weak points and prepared a triennial long term plan for eliminating all critical and health threatening points. Among all safety activities taken on the farm during the past year, the assessment of the hay cutting machine can be mentioned. Five life threatening factors were recognized with this machine, including: organ amputation, rock hurling, heavy cargo carriage, falling into the machine, and dust production.

Eventually the safety issue was solved by instilling a fodder conveyor belt into the machine. Another taken action was to create a separated sidewalk for the staff to prevent accidents with the vehicles.

Installing safety lines and warning signs in the farm were the other important activities that were performed to provide staff safety conditions. Safety assessment in both of the farms was performed by Nestlé SHE experts and after that, the list of related issues was prepared and the issues in the farms were solved based on a high risk priority. A separated sidewalk was also designed and built in the farms for staff commuting and the reduction of contact with staff, cars, and vehicles. In addition to preventing accidents, the staff were commuting using this special sidewalk from the farm entrance till office area.

Different training sessions were held in the farms aiming at enhancing labour conditions and overall welfare on the farms, which eventually lead to an increase in knowledge across all the farm workers. Workers with higher technical knowledge will have better conditions and there will be a possibility to increase their performance in the future. It will also prevent the occurrence of any accidents caused by lack of technical knowledge. The farm's fodder ensiling workshop, the aflatoxin reduction workshop and control in farm, waste water management by Nestlé SHE team, the animal welfare workshop, and training sessions for the increase and maintenance of soil quality in the Iran Veterinary Organization were among these training sessions which were held in the Nestlé conference centre and the conference centre of the Veterinary Organization. In addition to the ranchers, the farm workers, some experts from the "Veterinary Organization", and the "Agriculture Jahad Organization of Qazvin province" participated in these workshops. The presence of governmental organization representatives was a motivation for the farm workers to participate in these sessions.

Chopper


Pull type processors



Installing warning signs in dangerous areas


Using conveyors to convey the alfalfa to the alfalfa chopper

7. Farm Management

From the very beginning of the mutual cooperation of Nestlé and the two milk supplier farms, there were significant changes in the management of both farms. Both farm managers put enthusiastic efforts to enhance the existing labour conditions.

- Staff Management

Both farm managers in cooperation with Nestlé experts, the "Veterinary Organization", the "Agriculture Jahad Organization", and the "Qazvin Province's Department of Environment" provided the necessary facilities in the factory and farms to hold training sessions for different areas of farm activities. After holding these training sessions, the knowledge and motivation level of the farm staff increased significantly and it was possible to have efficient feedback from these staff in future. The workshop of feed and milk quality principals, silage, animal welfare, work safety principals on the farm, solving DMAIC and GSTD problems, and workshops on using infrared cameras in the farm were among these training sessions.

The establishment of an HR department in the farms was another new management activity performed. This department will create better labour conditions for the staff by better monitoring of contracts, which will lead to better performance of the staff in completing their duties.

- Production Safety

Since epidemic diseases in herds are considered as the biggest production safety threat in farms, the concept of zoning was conducted on the farms and as the first action in this regard, disinfectant soaking baths with proper spray systems were activated on the entrance doors of each farm.

In this regard, protocols for Biosafety in epidemic disease were inserted in the long term triennial plan of the farms. One of the farms supported the neighbouring small farms with lower financial wealth, in terms of vaccination and prevention of diseases spread, thus, resulting in the significant deduction of contamination in the region. Ultimately, there were no symptoms of the sickness in the farm in the past year.

Humans and machines' disinfection holes

Nestlé Iran visiting the rotary milking parlor

2016 Mycotoxine Conference Qazvin Factory

Nestlé Qazvin Factory agriculture services team and Alltech organized 2 days Mycotoxin management conference and farm visit on 31st May and 1st Jun where more than 30 farm experts from different Qazvin dairy farms and Government official from Iranian veterinary organization and dairy farms union participated

Presentation of best practices of manure management in modern dairy farms in Nestlé Iran with presence of agriculture ministry HEAD of EPO and IVO

Waste water management consultancy to farm in Nestlé factory with collaboration of SHE team and agriculture services and visit of Nestlé waste water site

NCE training courses and farm assessment and implementation

- Quality Management

As mentioned in the previous section, the first and the most important step for quality management was to put in place a specialist expert as the quality control manager in both farms that would lead to the preparation and execution of all protocols and standards of the farms. Both farms were equipped with laboratories to identify and control the quality of the purchased feed, and as a result the feed quality and ultimately milk quality had a significant rise. The remaining hygienic factors followed such as somatic cells, TPC, and bedding protocols lead to prevention of chronic disease, and a reduction in treatment expenses and the culling rate of the herd. All these activities were discussed in weekly meetings between the company and farms.

- Strategy & Planning Management

One of the most important management improvements in these farms was to define a triennial road map for them. For this, some meetings were held with the farm manager to define the targets of the farm in next three years. Based on decisions made in these meetings some road map signs were installed in the farm with minor projects undertaken to achieve these priorities. In this regard, some standards were defined for measuring the progress of the projects.

In order to analyse all these projects, weekly and monthly meetings were held with farm managers. All critical factors for reaching a beneficial integrated unit were analysed during these meetings. The overall quality, respect for environment, staff health, and increasing the efficiency in both farms were amongst the subjects discussed.

In the next step, in order to reduce waste in the farm processes and activities, and in order to increase the efficiency of both farms, "Lean Dairy Farming" was initiated. This project was executed by holding a three-day workshop with the participation of Nestlé experts and both milk supplier farms.

After these workshops, a roadmap for waste reduction in the milking area was executed in October 2016, taking into account time constraints and material used in the feed preparation factory, aiming at increasing the efficiency of the processes and preventing raw material waste.

This workshop created an opportunity for the managers of both farms to have mutual interactions on their knowledge, information, and experiences and also to benefit from Mr. Paskal's information. The results of this workshop were described in a roadmap for decreasing waste and increasing benefit of the farms. Dust reduction in the feed factory, the optimisation of water consumption in the milking process, and standardisation of all crucial activities in the farm are among the defined projects in this workshop.

Strategy management and 3-year planning

Holding lean dairy farming educational workshop

Educational workshops

Checking different diagrams of 3-year goals advancement and holding livestock integrated management workshop

Sources:

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انتقال ضایعات سیلو توسط سیستم کاملاً محافظت شده پس از زه‌کشی
Transferring silos‘ waste products by a completely preserved system, after drainage

پسماند آب قبل از زه‌کشی
Waste water before drainage

استفاده از کانوایر برای انتقال علوفه
Using a conveyor to convey the feed

تأمین بستر مناسب برای حیوانات
Providing suitable beddings for animals

تأمین علوفه سالم و تازه

Providing fresh and high-quality feed

تأمین جایگاه‌های مناسب با تراکم دامی در جهت رفاه حیوانات

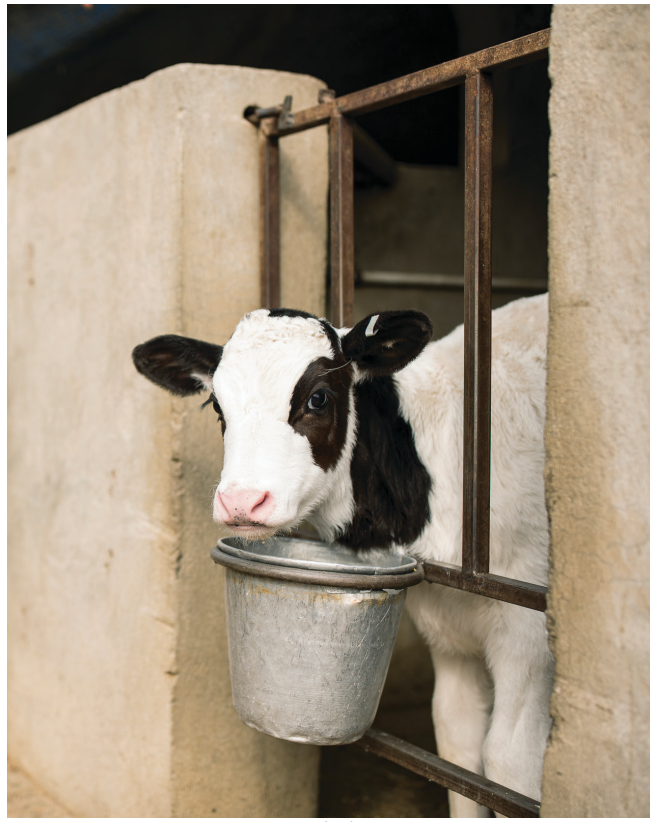
Providing suitable places with enough density for animals' welfare

جایگاه گوساله‌ها

Calves' stables

تأمین روزانه آب تازه و مناسب برای حیوانات
Daily provision of suitable fresh water for animals

جمع‌آوری روزانه کود در فری‌استال‌ها
Daily collection of manure in free stalls



جایگاه گوساله
Calves' stables

اختصاص جایگاه متفاوت برای بیمارستان دام‌ها
Allocating a different place for animals' hospital

جایگاه‌های مناسب برای نگهداری گوساله و کاهش تراکم حیوانات برای رفاه بیشتر و به صورت دسته‌جمعی در سنین بالای یک ماه
Suitable places to keep calves older than one month in groups, and reduce animals' density for more welfare