Original Article

Journal of Food Safety and Hygiene

journal homepage: http://jfsh.tums.ac.ir

Hierarchical cluster classification of Iranian food manufacturing and processing industries

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ARTICLEINFO

Article history:
Received 17 Feb. 2018
Received in revised form
28 May. 2018
Accepted 07 Jun. 2018

Keywords:
Hierarchical cluster;
Food manufacturing;
Industries

ABSTRACT

Clustering is a recognized data mining practice, which comprises the devising of a set of objects into a suitable classification of compatible cases. Current cluster study of Iranian food manufacturing industries encompassed food manufacturing and processing practices regarding the number of employees, energy consumed, input and output materials streams, flow-diagram of processes and also the land area used individually. It was used SPSS Software along with Delphi Fuzzy set theory (incorporated with simple additive weighting) to classify about 57 Food Manufacturing and Processing Industries (FMPI) as a hierarchical cluster. According to the t-test analysis, there is no significant difference among 57 FMPI and their criteria such as employees, power, water, land, and fuel. The obtained results were revealed the ranks values (weights) around 2.17, 3.95, 1.64, 2.26 and 4.98 for employees, power, water, fuel, and land criteria extracted from both Kendall's W and Friedman tests respectively. Also, it was found values around 180.749 and 0.793 for Chi-square and Kendall's Coefficient of Concordance in the Friedman and Kendall's W tests respectively. Mean Cronbach's Alpha based on the mean Eigenvalue was acquired about α=1. Pearson correlation analysis had shown the highest correlation between both factors of land and employees about 0.798. Finally, a hierarchical cluster classification was developed for the 57 FMPI.

Citation: Hassanpour M. **Hierarchical cluster classification of Iranian food manufacturing and processing industries.** J Food Safe & Hyg 2018; 4(1-2): 27-40

1. Introduction

The food industry is one of the prominent processing industries that is undergoing major developmental stages in food processing practices and technologies. It always needs to ensure the safety and quality of the food products. Various factors are involved in buying food products and attracting customers to purchase and maintain market prosperity.

These factors play a significant role in all stages of food generation, encompassing processing, handling and maintaining its safety. Available data for FMPI is not sufficient in terms of water, fuel, power, consumptions, as well as a land area used, input and output materials streams. The FMPI are important for human survival and are also the main consumers of energy. According to recent studies over 66% of global freshwater exploitation is taken into account for FMPI. Many studies revealed that the global population growth is predicted to rise by 33% between 2011 and 2050, consequently comes into view over 9 billion inhabitants. The demand for food is expected to rise around 60% (Based on the recent report published by the United Nations World Water Assessment Program, 2016) (1).

Nowadays, food manufacturing modernized, developed and focused on employing high levels of technology for generation and also logistics strategies to escalate efficiencies or design innovative food products. This is while our knowledge even is not sufficient about running FMPI technologies (2). The food industry has an important impact on consumption

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patterns and assigns relevant technologies to convert raw products to fresh food for human demand. Variety of pathways and channels posed to mature, in which fresh foods can be generated (1). One-off production: This practice is employed when the customer orders a food item in his or her own will and favor like a birthday cake (2). Batch production: In this method, the market inventory for this type of food is ambiguous, and only in certain circumstances or in a particular production line, it is possible to order or procure this product. A determined amount of the identical commodities will be generated to compose a batch (3). Mass production: it takes into consideration a mass market or a heavy demand for huge amounts of same products which must undergo multiple lines of generation processes. For instance, various chocolates, ready meals and canned products (4). Just-in-time production: It is a type of food provision is seen as a common situation in small units like restaurants. All compounds of the food are accessible wherever we seek and the clients select whatever they need as prepared in a kitchen, or in front of the buyers (3,4).

Delphi Fuzzy methods help us to make the decision about available options when we have lots of criteria and factors. Different Multi-Criteria Decision-Making (MCDM) methods are utilized various computational levels and processes for data processing practices so depending on the diversity of data, various outcomes will be derived and released. In order to use a particular method, knowledge, and experience of specialists and decision makers play a key role to conduct and assign a proper pattern. In most real ambient, factors or criteria and their constraints are not definitive and cannot be realized especially; they are called uncertain or Fuzzy criteria. To employ a proper MCDM procedure under a Fuzzy situation, present research investigated and statistically ranked the FMPI base on 5 criteria such as fuel, water, and power consumptions values, number of employees and the land area used for around 57 FMPI as a certain cluster (5). Also, the current study comprised enough information about input and output material streams and full flow-diagrams of FMPI. The current research comprised the raw data calculated by Iranian evaluator team from both Iranian Industries Organization (IIO) and Iranian environmental protection Agency (IEPA). In this research, the data were processed in order to classify the industries. Halim lim et al. (2017) Hoffmann (2010) Rahimi et al. (2013) and Banaeian et al. (2018) have performed studies about food manufacturing industries using statistical and Delphi fuzzy procedures (6-9).

2. Materials and methods

2.1. Source of data, Kendall's W and Friedman tests

Current cluster study comprised the data of about 57 FMPI. Data related to FMPI were collected from database published by IIO in the national language. Our data are the findings of the evaluator team of both IIO and IEPA once before the establishment of each industry. IBM SPSS Statistic 20 software was used to analyze the sub-criteria of industries.

In the Friedman test analysis, data appear as a matrix of [Xij] n×k. It is a matrix containing n rows and k columns that investigates the ranks within each block with a single result. In the matrix of [rij] n×k the entry rij is the rank of Xij within block i according to equations 1 to 5. The test statistic is calculated by equation 5.

Kendall's W calculates and manages the outcomes regardless of the probability distribution and linearly regarding the average value of the Spearman's rank correlation coefficients among discovered ranks. By the way, each object of I, is included the rank of rij for total n objects and m values. The following equations of 6 to 9, were applied to compute the ranks values. In equation 8, S is the sum of squared deviations. In order to normalize and review the agreement between the results of the Friedman test, Kendall W test is used. In concluding the agreement, the result is presented with W, as zero (full agreement) and one (lack of agreement). The equation 9 is used to calculate the value of W by SPSS software (10).

2.2. Fuzzy set theory

The weighing system was set based on, $\sum_j^n \mathrm{Wj}.\mathrm{Wij}$, (j=0-1). Wij is the existing values in the matrix after the normalization process individually. Table 1 denotes the Fuzzy set.

Then, Fuzzy numbers were assigned to evaluate the existing values. Ultimately, equation 10 was employed to prioritize existing options in the present study. It needs to explain that by present research, the Fuzzy numbers were used to prioritize industries via Simple Additive Weighting (SAW) method. Data were arranged according to the Likert system and were normalized based on fuzzy numbers and obtained special vector from the Friedman test, was introduced to collect the weights according to equation 10 (11,12).

$$\hat{r}.j = \frac{1}{n}\sum_{i=1}^{n} rij \quad (1)$$

$$\hat{r} = \frac{1}{nk}\sum_{i=1}^{n}\sum_{j=1}^{k} rij \quad (2)$$

$$SSt = n\sum_{j=1}^{.}(\hat{r}.j - \hat{r})^2 \quad (3)$$

$$SSe = \frac{1}{n(k-1)}\sum_{i=1}^{n}\sum_{j=1}^{k}(rij - \hat{r})^2 \quad (4)$$

$$Q = \frac{SSt}{SSe} \quad (5)$$

$$Ri = n\sum_{j=1}^{m}(ri, j, ..) \quad (6)$$

$$Rave = 1/n\sum_{i=1}^{n} Ri \quad (7)$$

$$S = \sum_{i=1}^{n}(Ri - Rave)^2 \quad (8)$$

$$W = \frac{12\ S}{m^2(n^3 - n)} \quad (9)$$

$$A = \sum_{j}(Wj.Wij) \quad (10)$$

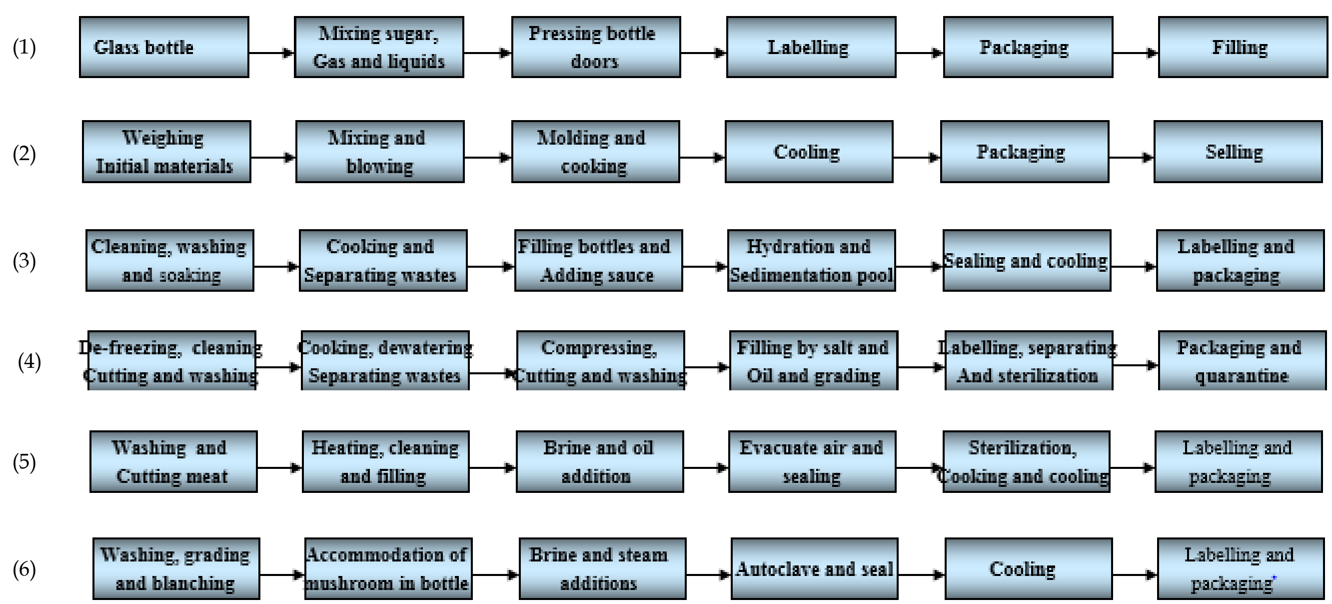
3. Results

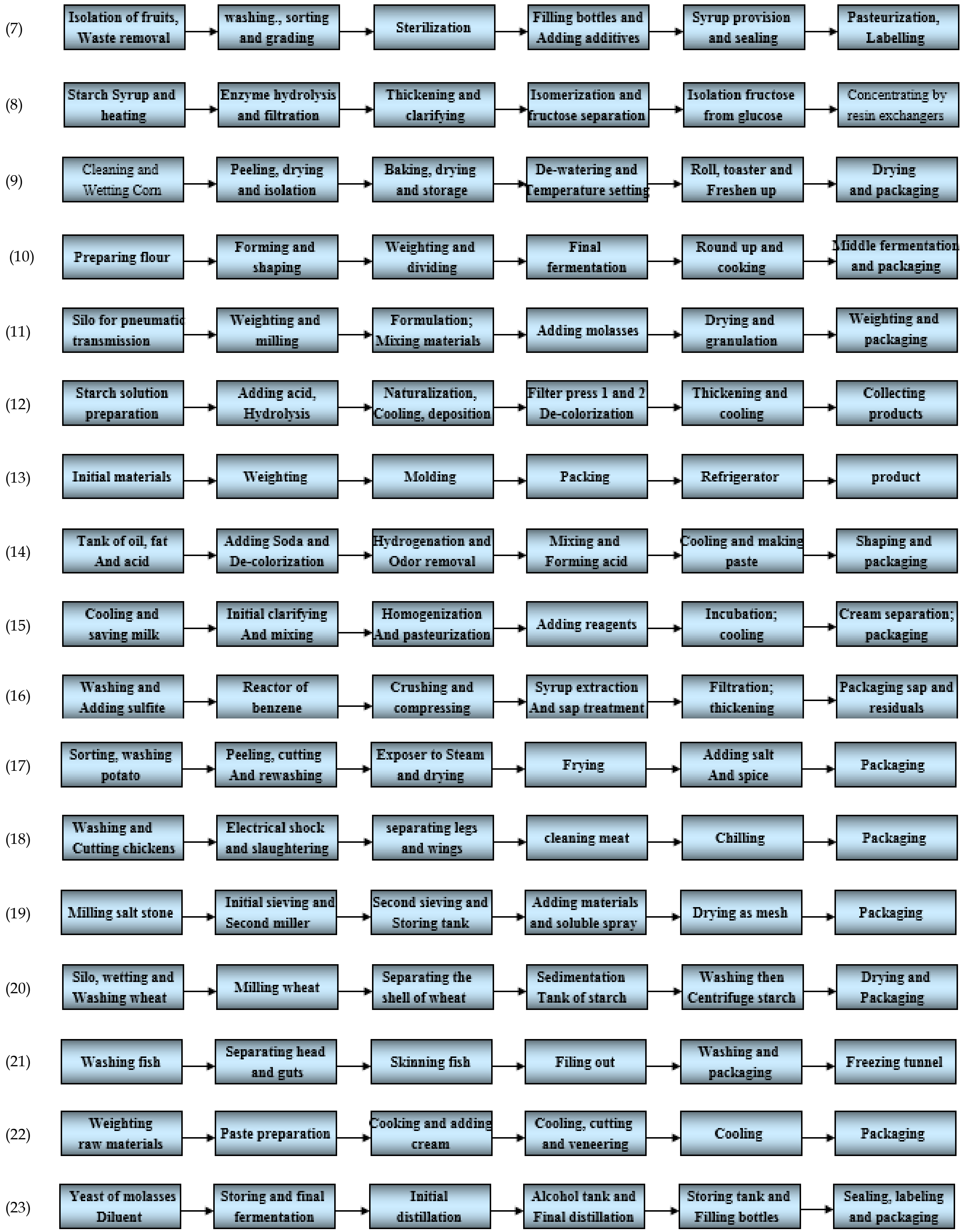
Figure 1 and Table 2 show FMP practices in Iranian industries and input materials introduced into Iranian FMPI. Table 3 displays FMPI, number of staff, land area used and energy consumptions.

In this study, the Friedman test was used to evaluate 5 independent criteria based on real data, by which weighting style for the columns containing the large, medium and small values follow the same pattern. It means that the column containing large values produce large weight value and vice versa. Therefore, the results can be used as a weighing system for ranking options. But for future industrial development goals, Entropy Shannon's weighing system has had excellent results with negative and positive criteria. The obtained results were revealed the rank (weights) values around land (4.98)> power (3.95) > fuel (2.26) > employees (2.17) > water (1.64) from both Kendall's W and Friedman tests respectively. Therefore, the vector of weights (WJ) was determined based on the obtained values. Tables 4 and 5 display criteria/symbols versus factors based on Likert spectrum and decision matrix set in the fuzzy system respectively.

Table 1. Delphi Fuzzy set

Symbol	VL	L	SL	M	SH	H	VH
Verbal words	Very low	Low	Slightly low	Medium	Slightly high	High	Very high
Real value	(0.09,0, 0.1)	(0.2, 0.1, 0.1)	(0.3, 0.1, 0.2)	(0.5, 0.1, 0.1)	(0.6, 0.1, 0.2)	(0.8, 0.1, 0.1)	(0.85, 0.1, 0)
Fuzzy number	0.1362	0.2272	0.3695	0.5	0.6304	0.7727	0.8636

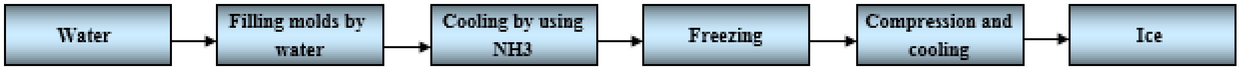



(7) Isolation of fruits, Waste removal → washing., sorting and grading → Sterilization → Filling bottles and Adding additives → Syrup provision and sealing → Pasteurization, Labelling
(8) Starch Syrup and heating → Enzyme hydrolysis and filtration → Thickening and clarifying → Isomerization and fructose separation → Isolation fructose from glucose → Concentrating by resin exchangers
(9) Cleaning and Wetting Corn → Peeling, drying and isolation → Baking, drying and storage → De-watering and Temperature setting → Roll, toaster and Freshen up → Drying and packaging
(10) Preparing flour → Forming and shaping → Weighting and dividing → Final fermentation → Round up and cooking → Middle fermentation and packaging
(11) Silo for pneumatic transmission → Weighting and milling → Formulation; Mixing materials → Adding molasses → Drying and granulation → Weighting and packaging
(12) Starch solution preparation → Adding acid, Hydrolysis → Naturalization, Cooling, deposition → Filter press 1 and 2 De-colorization → Thickening and cooling → Collecting products
(13) Initial materials → Weighting → Molding → Packing → Refrigerator → product
(14) Tank of oil, fat And acid → Adding Soda and De-colorization → Hydrogenation and Odor removal → Mixing and Forming acid → Cooling and making paste → Shaping and packaging
(15) Cooling and saving milk → Initial clarifying And mixing → Homogenization And pasteurization → Adding reagents → Incubation; cooling → Cream separation; packaging
(16) Washing and Adding sulfite → Reactor of benzene → Crushing and compressing → Syrup extraction And sap treatment → Filtration; thickening → Packaging sap and residuals
(17) Sorting, washing potato → Peeling, cutting And rewashing → Exposer to Steam and drying → Frying → Adding salt And spice → Packaging
(18) Washing and Cutting chickens → Electrical shock and slaughtering → separating legs and wings → cleaning meat → Chilling → Packaging
(19) Milling salt stone → Initial sieving and Second miller → Second sieving and Storing tank → Adding materials and soluble spray → Drying as mesh → Packaging
(20) Silo, wetting and Washing wheat → Milling wheat → Separating the shell of wheat → Sedimentation Tank of starch → Washing then Centrifuge starch → Drying and Packaging
(21) Washing fish → Separating head and guts → Skinning fish → Filing out → Washing and packaging → Freezing tunnel
(22) Weighting raw materials → Paste preparation → Cooking and adding cream → Cooling, cutting and veneering → Cooling → Packaging
(23) Yeast of molasses Diluent → Storing and final fermentation → Initial distillation → Alcohol tank and Final distillation → Storing tank and Filling bottles → Sealing, labeling and packaging


(24) Pumping spring water → Coagulation and chlorination → Sand and active Carbon filtration → Micro and cartridge filtration → Sterilization by UV And filling bottles → Packaging
(25) Separating and Cleaning sands → Cleaning wastes and seeds → Washing and preparing → Milling and sieving → Packaging → Storing at warehouse
(26) Harvesting, carrying and peeling → Removing wastes, Wash and clean → De-watering and drying → Packaging → Second: Adding salt: curing → Powdering and Packaging
(27) Shaking and pneumatic sieves → Removing wastes, Sand → Cleaning → Sorting → Packing machine → Packaging
(28) Sorting and cleaning → Drying → Milling → Packaging at silo → Packing By cartons → Reservoir
(29) Washing pond → Conveyor → Sorting, washing and disinfection → Polish or waxing machine → Dryer tunnel → Grading and packaging
(30) Wafer paste → Preparing and cooking → Adding cream and cooling → Cutting pieces → Refusing wastes → Packaging
(31) Initial cleaning corn → Secondary cleaning and removing waste → Wetting and Removing sprout → Crushing seed → Milling and Producing grits → Packaging
(32) Weighting initial materials → Mixer → Rotary mold → Tunnel oven → Packaging conveyor → Packaging
(33) Cleaning, milling Peeling soya → Silo for mixing flour → Storing, mixing With water: paste → Rotary conveyor of paste to extruder → Cutting strings; Producing granule → Drying, cooling Sieving and packing
(34) Seed and soil → Composting and cultivating → Covering by soil and harvest → Preparing for Packaging; grading → Discharge extra compost → Disinfection
(35) Preparing milk → Adding fermenter → Cutting → Dewatering → Molding → Adding salt and Packaging
(36) Pasteurization and separation → Sedimentation tank; separating flocks → Washing by hot water → cooking and molding → Cooling and cutting → Refrigerator
(37) Tank for meat waste → Crushing meat and cooking pot → Temporary saving reservoir → Centrifuge, press; Sieve and mill → Silo, adding oil → Packaging
(38) Crushing, cleaning and cooking fish → Filtration, press solidification → Centrifuge and Adding acetic water → Evaporating and drying → Mill and cyclone → Packaging
(39) Feeder → Weighting and Mixing dye → Adding plastic material → Mixing dye, plastic And gum → Extruding and cutting → Check and final packaging
(40) Honey comb → Extractor or mixer machine → Reservoir having Filter and heater → Reservoir having Fine filter and cooler → Storing tank → Packaging


(41)
Milling and washing Salt and centrifuge
Drying by hot air and milling
3 floors sieve
Reservoir and Iodine addition
clarification
Packaging
(42)
Milk tank
Heating and mixing
Homogenization
Separation
Adding dye
Packaging
(43)
Cleaning and Separating dates
Disinfection
Final check
Drying and washing
Separating and sorting
Packaging
Opening dates and Separating core
Crushing and Extracting juice
Filtration and Re-filtration
Purification, PH Check up; filtration
Evaporation and pasteurization
Sorting and Packaging
(44)
Cleaning, wetting; adding salt to fish
Fish filleting
Washing and drying
Hanging in the smokehouse
Burning, grading and storing
Packaging
(45)
Washing, wetting tomatoes
Sorting, washing Crushing and baking
Filtration and formulation
Thickening, pasteurization
Filling cans, sterilization
Washing, drying Labeling; Packaging
(46)
Flour and additives
Mixing and curing paste
String paste maker machine
Baking at steam Tunnel; fried
Cooling and packing
Products
(47)
Olive
Washing and Removing leaves
Oil extraction
Naturalization and clarification
Filtration
Products
(48)
Vegetable seeds
Sieve, cyclone and grit chamber
Drying and storage silos
Expeller and baking machines
Press, sedimentation Chamber
Weighting and Storing product
(49)
Oily seeds preparation
Heating, baking and pressing seeds
Waste and shell Removal of seeds
Naturalization and producing soap
Washing, centrifuge and clay filter
Curing by steam; Final curing
(50)
Cleaning and washing
Dewatering and Checking vegetables
Chopping
Drying
Rechecking
Packaging
(51)
Storing and baking wheat
Adding brine for 1-2 weeks
Keeping paste at tank for 5 months
Baking soya juice; Sedimentation tank
Mixing with SiO2 Powder; filtration
Filling and sealing Bottles; Packaging
(52)
Washing and Cleaning tomatoes
Pressing, thickening and filtration
Homogenization, Baking
Adding aromatics, Filling and sealing
Pasteurization, Labelling
Packaging
(53)
Vacuum mixing additives
Homogenization, Filling bottles
Sealing glasses and bottles
Baking
Pasteurization, Labelling
Products
(54)
Cleaning and washing raisin
Adding sulfur
Drying
Impurity removal
Adding oil and Quality promotion
Product
(55)
Cleaning and Washing dates
Disinfection
Dewatering
Drying and setting moisture
Separation, division sorting
Product
(56)
Curing and Weight materials
Chopping and mixing
Making Emulsion
Filling and Hanging; baking
Touching with Smoke; peeling
Slicing and packaging

(57)



Up to down; Non alcoholic beer (1), Cake and muffins (2), Canned Beans and Caviar Eggplant (3), Canned fish (tuna) (4), Canned meat (5), Canned mushrooms (6), Compote (7), Concentrated fructose syrup of corn sugar (8), Corn Flakes (9), Industrial Bread (10), Marine food (11), Glucose from starch (12), Hamburger (13), Margarine (14), Milk, yogurt and pasteurized cream (15), Date sap (16), Potatoe based foods (17), Poultry slaughterhouse (18), Iodinized salt (19), Starch from wheat (20), Treating fish (21), Waffer chocolate (22), Alcohol from beet molasses (23), Mineral water (24), Wheat flour (25), Pistachio packaging (26), Packing grains; peeling off barley (27), Spice Packing (28), Fruit packaging (29), Wafer biscuits (30), Corn grits (31), Biscuit (32), Soya protein (33), Mushroom cultivation (34), Cheese from fresh milk (35), Pizza Cheese (36), Meat and Olive Industrial Powder (37), Fish powder (38), Artificial sausage and sausage coating (39), Preparation; packaging of honey (40), Purification and packaging of salt (41), Cream dye (42), Dates and liquid sugar (43), Smoked fish (44), Tomato paste (45), Flour string (46), Olive oil (47), Oil Seeds from Vegetable Seeds (except soya; olive) (48), Drying oils (49), Dried vegetables (50), Soya sauce (51), Ketchup (52), Food sauces (53), Raisin Packaging (54), Dates packaging (55), Sausage (56), Ice (57).

Figure 1. Food manufacturing and processing practices in Iranian industries [This study]

Table 2. Input materials introduced into Iranian FMPI [This study]

Industry	Initial materials
(1)	Concentrated malt juice (410t); Sugar (700t); Bottles labels (30.5 millions); Glass bottles of 330 ml (30.2 millions)
(2)	Flour (254500 kg); Eggs (35600 No); Sugar (139200); Milk (45450 kg); Oil (45400 kg); Baking powder (6 kg); Flavors (4 kg); Cellophane (1575.6 No); Carton (226931 No): Gum (1000 kg)
(3)	Pinto beans (512t); Tomato paste (153t); Salt (2t); Oil (20.5); Cans (3700 No); Carton (2840 No); Tomato (263t)
(4)	Fish (2820t); Cans with capacity of 200 g (11220 No); Salt (90t); Oil (393t); Paper labels (11000 No); Packaging cartons (229200 No)
(5)	Meat (1950t); Salt and NO_2 (34.5t); Cans with capacity of 200 g (6825 No); Paper labels (6825 No); Packaging cartons 20*33*30 cm^3 (142543 No); Oil (101.5t)
(6)	Agaricus mushrooms (778t); Salt (31t); Cans with capacity of 500 g (2800 No); Paper labels (2800 No); Cardboard (58500 No)
(7)	Various fruits (2037t); Pure sugar (335t); Acid acetic (4 No); Cans, 0.5 kg (8320000 No); Labels (8400000 No); Packaging carton containing 48 empty spaces (165000 kg); Vitamin C (126 No)
(8)	Corn starch (7200t)
(9)	Corn (561t); Sugar (95.5t); Salt (11.1t); Liquid sugar cube (14t); Glycerol Mono Stearates (2.2t); Malt juice (5t); Banana juice (2.4 t): Pre-mixed vitamin of 7 types (1.7t); Packaging plastic with width of 43 and 61 cm (38400 and 120000 No); Cardboards of 30*16*5, 38*25*5, 50*32*24 and 50*50*38 cm^3 (1600, 400000, 80000 and 20000 No)
(10)	Flour (750t); Salt (17t); Sugar (30t): Cooking oil (20t); Fermentation powder (8.75t); Additives (6t); Eggs (15t)
(11)	Cereal flour (2400t); Fish powder (3000t); Starch (1800t); Soya powder (840t); Grain (2400t); Sugar beet molasses (840t); Fat (720t)
(12)	Starch (2181600 kg); HCL (15196 kg); $NaCO_3$ (4527 kg); Perlite soil (32562 kg); Active carbon (9769 kg); Filter cloth (910 m); Barrels (1206 No)
(13)	Meat (504000 kg); Soya (72000 kg); Guillotine (80000 kg); Onion (150000 kg); Salt (20000 kg); Spice (10000 kg); Toasted flour (92000 kg); Waxy paper (20000 kg); Packaging carton (50000 kg); Cooking oil (50000 kg)
(14)	Vegetable oil (9600t); Salt 2-3% (360t); Additives (24t); Beta carotene (12t); Emulsifier (36t); Clay soil (50t); Sorbic acid (18t); Anti-oxidant (550 kg); Filtration materials (8t); Catalyst (5t); Packaging materials (300000 No)
(15)	Milk (8400t); NaOH (30t); HNO_3 (21t); Sodium hypochlorite (1t); Al sheets (12.8t); Glass bottles (2000 No); Plastic bags (56t); Boxes holding 20 and 60 empty spaces (100 and 35 No)
(16)	Date (2000t); Plastic gallon, 200 kg (6000 No); Lime, package of 50 kg (20t); Active charcoal, package of 50 kg (3t)
(17)	Potato (900t); Liquid oil (61.2t); Salt (21t); Spice (8.5t); Cellophane 15*24 and 20*25 cm^2 (2000 and 4000 No); Cardboard boxes containing dimension of aound 15*15*20 cm^3 (2000 No); Cardboard cartons containing dimension of around 75*75*40 cm^3 (40000 No); LDHP containing dimension of around 20*30 and 100*40 cm^2 (40000 and 1800 No);
(18)	PE plastic, 5 g for each hen (18900 No); Carton (378000 No); Disinfectant (CL_2), (550 kg); $FeCl_3$ (2650 kg); Poly-electrolyte (275 kg); Caustic soda (570 kg)
(19)	Salt stone 97% (12000t); KI (550 kg); Sodium thiosulfate (105t); CO_3 (21t); LDPE (25.2t); HDPE (38.5t)
(20)	Wheat containing moisture of 14% (1600t); PP and plastic sacks, 40 kg (0.96 and 2.92t); Cartons (27200 No)
(21)	Fish (1350t); Ice (1000t); NH_3, capsules of 60 kg (5 No); Additives (130 kg); PE packaging materials (150 No); Cartons (8920 No); Plastic wrap (1300 kg); Disposable tableware (41200 No); PE film (1050 kg); PE boxes, 60 kg (200 No)
(22)	Flour (195.75t); Oil (90.5t); Sugar 99.8% (126.25t); Chocolate (85.25t); Dry milk (6.5t); Lecithin (4t); Baking soda (500 kg); Ammonium bicarbonate (750 kg); HNO_3 (500 kg); Freshener (250 kg); NaCl (500 kg); Al foil (30.75 kg); Boxes with size of 8*8.4*14 cm^3 (842500 No); Cartons of 20 kg (25250 No)
(23)	Beet molasses, 45-50% sugar (5400t); Yeast (2900 kg); Types of Ammonium Salt (14100 kg); H_2SO_4, 98% (37800 kg); Sugar (7800 kg); Anti foam (4000 L); Bottles of 600 cm^3 (1417 No); Label (1390 No); Cartons having 12 empty spaces (114750 No); Tape (2500 No)
(24)	Spring water (12000 m^3); Cl_2 (135 kg); Active carbon (80 kg); Plastic containers (12000 pieces)
(25)	Wheat containing moisture of 10-14% (100t)
(26)	Raw pistachio (1500t); Salt 99.21% (45t); Starch (15t); Citric acid (35t); Cellophane (12t); N_2 (15t); Cardboard carton (30t); Packaging glue (300 kg); Methyl bromide (900 kg)
(27)	Grains (1251.5t); Barley (1373t); Cellophane (22624 kg); Carton (230500); Tablets (1700 No)

(28)	Cinnamon, 13% moisture (31.5t); Turmeric,10% moisture (84t); Red pepper, 13% moisture (31.5t); Black pepper, 12% moisture (42t); Ginger, 12.5% moisture (21t); Cardamom, 13% moisture (21t); White pepper, 15% moisture (31.5t); Packaging materials (6562 kg)
(29)	Especial boxes (505000 No); Cardboard boxes (404000 No); Perchlorine and methyl (1005 kg); Paraffin materials for polishing (5025 kg); Waxy paper (7575 kg)
(30)	Dry milk (1.3t); Lecithin (1.02t); Freshener (2t); Ammonium bicarbonate (2t); Citric acid (2t); Al foil (2.06t); Wheat flour (486t); Sugar (310t); Vegetable oil (224t); Sodium Bicarbonate (1.03t); Carton in dimension of 18*24*45 cm^3 (2.04t)
(31)	Corn, 2-10% moisture and 37% carbohydrate (6000t); Plastic sack, sizes of 50*80 cm^2, capacity of 50 kg made of PP (120000 No)
(32)	Flour (683.4t); Sugar (122.4t); Vegetable oil (112.2t); Glucose (60.6t); Freshener (1010 kg); Cellophane for packaging (3800 kg); Carton (188700 No); Dry milk (20200 kg); Sodium Bicarbonate (14140 kg); Salt (5050 kg)
(33)	Soybean meal, containing 36.7% protein (2470t); Pocket (115000 No)
(34)	Straw (375t); Fertilizer (185t); Seed (15t); Urea (15t); Sugar beet molasses (15t); Hydrated plaster (28t); Toxicant (1000 L); Plastic dishes 0.5 and 1 kg (100000 and 50000 No); Cellophane (3750 No); Label (150000 No)
(35)	Cow milk, containing 3.5% fat (7500000 kg); Cheese fermentative powder (20 kg); Calcium chloride (30 kg); Lactic materials (2000 kg); NaCl (60000 kg); Washing materials (6000 kg); Cans, 17 kg (18000 No); Tin (500 kg)
(36)	Milk (324.111 kg); Vegetable oil (23058 kg); Cheese (3240 kg); Sodium citrate (651 kg); Cheese fermentative powder (32.4 kg); Cellophane (1515 kg); Carton (5100 kg); Plastic covers (15150 kg); Disinfectant (136 kg)
(37)	Meat wastage (1575000 kg); Salt (9500 kg); Anti-oxidant (125 kg); Packaging bag (10000 No); Packaging barrels (284 No)
(38)	Fish (2500t); printed bags for packaging targets (10000 No)
(39)	Poly amid-11 (74t); LDEP (123t); Bonding agent (25.5t); Dye (25.5t); Cardboard boxes of about 20*20*30 cm^3 (85050 No); Carton with sizes of 30*40*60 cm^3 (14884 No)
(40)	Honey (458.28t); PE plates of 50 and 100 g (4582600 and 2291300 No); Al covers (2000 kg); Empty cartons, with sizes of 20*20*15 cm^3 (91600 No)
(41)	Salt (23700t); PE sacks of 40 kg (42600 kg); LDPE salt bags, 2-5 kg (13650 kg); LDPE cans of 700 g (3150000 No); Cartons of 24 empty spaces and 25*25*30 cm^3 in dimension (131250 No); Gum (480 No)
(42)	Milk (1610t); Rlu 120 oil (14000 L); Plastic bags (3.5t); Chemical dye (30.8t); Natural dye (5.5t); Washing liquid (28t); Sedimentation materials (28t); Salt (56t); PP sacks as roll (0.75t)
(43)	Date grades of 1; 2-3 (3000; 6000t); Perlite (210t); Moss powder (25t); Cao (40t); Asbestos (4200 m); Acid acetic 20% (11t); Alkaline solution, 40% (600t); HCl, 35% (700t)
(44)	Fish (180t); Salt (90t); Ice (225t); PE nylon (3t); Chip and dirt (410t); Carton (7575t)
(45)	Tomato (7500t); Salt (50t); HClO (2t); NaOH (4t); Label (2500 No); Liquid gum (10000 No); Cans of 0.5 kg (765 and 1530 No); Cartons of 24 empty spaces (64000 No)
(46)	Wheat flour, moisture 12% (262592 kg); Soya sauce (236736 kg); Salt 98% (47347.20 kg); Cooking oil (800 kg); Dried vegetables (80 kg); Monosodium (20 kg); Sugar (23673.60 kg); Spice (15 kg); Pepper sap (5 kg)
(47)	Olive (352.5t); Bottles of 1000 cc (72000 No); Three layers cartons of 25*35*45 cm^3 (3000 No); Labels (74300 No); Al caps of d= 30 mm (74300 No)
(48)	Sunflower seeds, 40% oil and 12% moisture (4550t); Cotton seed, 20% oil and 15% moisture (4550t); PE bags, 50 kg (112000 No); Filter facilities (2700 kg)
(49)	Oily seed (1500t); NaOH, purity of 99% (8t); H_2SO_4, 98% (60t); Activated bentonite (4t); Cans of 20 L (27000 No); PE bags, 50 kg (20000 No)
(50)	Broad leafy vegetables (2400t); Perchlorine (2400 L); Cardboard boxes of around 17*25*3 cm^3 (1470000 No); Reprinted carton of around 25*36*34 cm^3 (64167 No); Cellophane (2125 No)
(51)	Soy bean powder (100000 kg); Wheat (60000 kg); Salt (8000 kg); Water (98000 m^3); Flavoring materials (80 kg)
(52)	Ketchup (25000t); Sugar (660t); Salt (44t); Vinegar (130t); Spice (22t); Containers and accessories (13250 No); Packaging cartons with 24 empty spaces (552000 No); Preservatives (13.25t)
(53)	Vinegar 4% (97350 kg); Ketchup (211750 kg); Sugar (97350 kg); Onion (39655 kg); Oil (646800 kg); Starch (102850 kg); Eggs (68062 No); Glasses of 300 g (50750000 No); Glass caps (50750000 No); Labels (50750000 No); Cartons of 24 empty spaces (211459 No); Glasses of 120 g (1312500 No); Cartons of 60 empty spaces (21875 No); Plastic caps (1312500 No); Mustard powder (66000 kg); Mayonnaise sauce (114400 kg)
(54)	Raisin (1100000 kg); Carton (113625 No); Sulfur (1333.2 kg); Tape (170437.5 m); Polishing oil (10710 kg); Waxy paper (590 kg); Cellophane for packaging, 250 g (10200 kg)
(55)	Date (5000t); Methyl bromide (40t); Plastic bags, 5-20 kg (200000 No); Boxes (1500 No)
(56)	Meat (550000 kg); Casein (10000 kg); Flour (30000 kg); Soya (21000 kg); Dried milk (40000 kg); Starch (60000 kg); Phosphate (5000 kg); Ascorbic acid (900 kg); Nitrate and sodium nitrite (150 kg); Salt (25000 kg); Spice (23000 kg); Additives (30000 kg); Eggs (150 kg); Garlic (5100 kg); Sausage PE cover (1500000 m); PE sausage cover (1430000 m); Vacuum packing cover (500 kg); Oil (140000 kg)
(57)	Industrial grade salt, purity of 85% (2000 kg); NH_3 (24 capsules)

HDPE=High density polyethylene, LDPE=Low density polyethylene, PE= Polyethylene, PP= Polypropylene

Table 3. FMPI, number of staff, land area used and energy consumptions [This study]

Industry	Nominal capacity (t)	Employees	Power (kw)	Water (m^3)	Fuel (Gj)	Land (m^2)
(1)	30000000 No	82	161	95	83	9800
(2)	650	33	118	11	23	3100
(3)	3700 No	45	136	37	31	8100

(4)	11000 No+1056t	75	193	145	102	7200
(6)	2800000 No	28	82	24	38	6100
(5)	6500000 No	39	307	35	68	5200
(7)	8000000 No	68	133	81	46	11900
(8)	2400	31	71	7	5	3600
(9)	600	29	138	15	48	7100
(10)	1000000	14	95	5	5	1600
(11)	12000	17	1749	5	19	3400
(12)	2160	29	199	26	67	4600
(13)	1000	16	67	7	3	2200
(14)	12000	51	320	23	217	8600
(15)	8255	26	306	130	26	7200
(16)	2000	24	174	23	37	7100
(17)	800	31	216	39	37	7900
(18)	3780000 No	39	196	15	10	6400
(19)	10000	24	229	27	82	5700
(20)	1580	50	175	11	19	5300
(21)	1000	33	217	27	4	2400
(22)	500	21	92	4	12	2400
(23)	1500000 No	41	132	50	241	7100
(24)	12000	24	91	7	9	5500
(25)	27000	41	132	50	241	7100
(26)	1269.5	29	77	8	4	2700
(27)	2430	17	91	5	2	2900
(28)	250	13	64	4	6	1700
(29)	10000	39	122	51	41	4600
(30)	1000	19	87	15	20	3400
(31)	5800	49	301	31	123	9700
(32)	1000	19	87	15	20	3400
(33)	1900	26	292	16	99	5000
(34)	600	26	133	21	47	7700
(35)	1500	14	164	33	63	8000
(36)	1500	19	75	33	21	3000
(37)	545.5	16	120	8	20	3000
(38)	500	23	173	19	37	3000
(39)	243	35	258	29	4	3100
(40)	24000 No	13	60	5	19	3000
(41)	21600	28	509	30	10	10200
(42)	1400	124	807	87	145	23800
(43)	4680	64	524	40	103	16100
(44)	15	19	67	15	4	2400
(45)	1500	41	224	9	11	5800
(46)	24192 No	44	49	10	7	4800
(47)	280	19	269	55	62	3400
(48)	8000	33	128	10	60360	3600
(49)	1500	22	213	15	89	2000
(50)	1412000 No	33	138	27	69	3600
(51)	60000 barrels+72000 bottles	45	828	13	17	10700
(52)	16000	36	344	11	50	10400
(53)	4451998 (bottles 300 g)+1250000 (bottles 120g)	44	213	17	35	4500
(54)	1000	31	107	15	8	7600
(55)	400	16	193	4	3	2500
(56)	1000000	19	177	22	36	2900
(57)	12920	18	252	54	3	2100

Table 4. Criteria/symbols versus factors based on Likert Scale

Criteria /symbols	Employees	Power (kw)	Water (m^3)	Fuel (Gj)	Land (m^2)	Symbol
Very high	121-140	1001-1800	96-145	+ 250	16501-24000	VH
High	101-120	601-1000	56-95	201-250	12501-16500	H
Slightly high	81-100	401-600	41-55	101-200	10001-12500	SH
Medium	61-80	301-400	31-40	76-100	7501-10000	M
Slightly low	41-60	201-300	21-30	51-75	5001-7500	SL

Low	21-40	101-200	11-20	26-50	2501-5000	L
Very low	0-20	0-100	0-10	0-25	0-2500	VL

Table 5. Decision matrix set in the fuzzy system (This study)

Industry	Employees	Power	Water	Fuel	Land	Weights
(1)	SH(.6304)	L(0.2272)	H(0.7727)	M(0.5)	M(0.5)	7.152636
(2)	L(0.2272)	L(0.2272)	L(0.2272)	VL(0.1362)	L(0.2272)	3.20234
(3)	SL(0.3695)	L(0.2272)	M(0.5)	L(0.2272)	M(0.5)	5.522727
(4)	M(0.5)	L(0.2272)	VH(0.8636)	SH(.6304)	SL(0.3695)	6.663558
(5)	L(0.2272)	M(0.5)	M(0.5)	SL(0.3695)	SL(0.3695)	5.963204
(6)	L(0.2272)	VL(0.1362)	SL(0.3695)	L(0.2272)	SL(0.3695)	3.990576
(7)	M(0.5)	L(0.2272)	H(0.7727)	L(0.2272)	SH(.6304)	6.902532
(8)	L(0.2272)	VL(0.1362)	VL(0.1362)	VL(0.1362)	L(0.2272)	2.69365
(9)	L(0.2272)	L(0.2272)	L(0.2272)	L(0.2272)	SL(0.3695)	4.116654
(10)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	2.043
(11)	VL(0.1362)	VH(0.8636)	VL(0.1362)	VL(0.1362)	L(0.2272)	5.36941
(12)	L(0.2272)	L(0.2272)	SL(0.3695)	SL(0.3695)	L(0.2272)	3.96297
(13)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	2.043
(14)	SL(0.3695)	M(0.5)	SL(0.3695)	H(0.7727)	M(0.5)	7.619097
(15)	L(0.2272)	M(0.5)	VH(0.8636)	L(0.2272)	SL(0.3695)	6.23791
(16)	L(0.2272)	L(0.2272)	SL(0.3695)	L(0.2272)	SL(0.3695)	4.350026
(17)	L(0.2272)	SL(0.3695)	M(0.5)	L(0.2272)	M(0.5)	5.776021
(18)	L(0.2272)	L(0.2272)	L(0.2272)	VL(0.1362)	SL(0.3695)	3.910994
(19)	L(0.2272)	SL(0.3695)	SL(0.3695)	M(0.5)	SL(0.3695)	5.528639
(20)	SL(0.3695)	L(0.2272)	L(0.2272)	VL(0.1362)	SL(0.3695)	4.219785
(21)	L(0.2272)	SL(0.3695)	SL(0.3695)	VL(0.1362)	VL(0.1362)	3.544617
(22)	L(0.2272)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	2.24047
(23)	SL(0.3695)	L(0.2272)	SH(.6304)	H(0.7727)	SL(0.3695)	6.319523
(24)	L(0.2272)	VL(0.1362)	VL(0.1362)	VL(0.1362)	SL(0.3695)	3.402304
(25)	SL(0.3695)	L(0.2272)	SH(.6304)	H(0.7727)	SL(0.3695)	6.319523
(26)	L(0.2272)	VL(0.1362)	VL(0.1362)	VL(0.1362)	L(0.2272)	2.69365
(27)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	L(0.2272)	2.49618
(28)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	2.043
(29)	L(0.2272)	L(0.2272)	SH(0.6304)	L(0.2272)	L(0.2272)	4.069248
(30)	VL(0.1362)	VL(0.1362)	L(0.2272)	VL(0.1362)	L(0.2272)	2.64542
(31)	SL(0.3695)	M(0.5)	M(0.5)	SH(0.6304)	M(0.5)	7.511519
(32)	VL(0.1362)	VL(0.1362)	L(0.2272)	VL(0.1362)	L(0.2272)	2.64542
(33)	L(0.2272)	SL(0.3695)	L(0.2272)	M(0.5)	L(0.2272)	4.586613
(34)	L(0.2272)	L(0.2272)	SL(0.3695)	L(0.2272)	M(0.5)	4.999916
(35)	VL(0.1362)	L(0.2272)	M(0.5)	SL(0.3695)	M(0.5)	5.338064
(36)	VL(0.1362)	VL(0.1362)	M(0.5)	VL(0.1362)	L(0.2272)	3.092812
(37)	VL(0.1362)	L(0.2272)	VL(0.1362)	VL(0.1362)	L(0.2272)	2.85563
(38)	L(0.2272)	L(0.2272)	L(0.2272)	L(0.2272)	L(0.2272)	3.408
(39)	L(0.2272)	SL(0.3695)	SL(0.3695)	VL(0.1362)	L(0.2272)	3.997797
(40)	VL(0.1362)	VL(0.1362)	VL(0.1362)	VL(0.1362)	L(0.2272)	2.49618
(41)	L(0.2272)	SH(.6304)	SL(0.3695)	VL(0.1362)	SH(.6304)	7.036288
(42)	VH(0.8636)	H(0.7727)	H(0.7727)	SH(0.6304)	VH(0.8636)	11.918837
(43)	M(0.5)	SH(.6304)	SH(.6304)	SH(.6304)	H(0.7727)	9.881686
(44)	VL(0.1362)	VL(0.1362)	L(0.2272)	VL(0.1362)	VL(0.1362)	2.19224
(45)	SL(0.3695)	SL(0.3695)	VL(0.1362)	VL(0.1362)	SL(0.3695)	4.63263
(46)	SL(0.3695)	VL(0.1362)	VL(0.1362)	VL(0.1362)	L(0.2272)	3.002441
(47)	VL(0.1362)	SL(0.3695)	SH(.6304)	SL(0.3695)	L(0.2272)	4.755461
(48)	L(0.2272)	L(0.2272)	VL(0.1362)	VH(0.8636)	L(0.2272)	4.697024
(49)	L(0.2272)	SL(0.3695)	L(0.2272)	M(0.5)	VL(0.1362)	4.133433
(50)	L(0.2272)	L(0.2272)	SL(0.3695)	SL(0.3695)	L(0.2272)	3.96297
(51)	SL(0.3695)	H(0.7727)	L(0.2272)	VL(0.1362)	SH(.6304)	7.673792
(52)	L(0.2272)	M(0.5)	L(0.2272)	L(0.2272)	SH(.6304)	6.493496
(53)	SL(0.3695)	SL(0.3695)	L(0.2272)	L(0.2272)	L(0.2272)	4.278876
(54)	L(0.2272)	L(0.2272)	L(0.2272)	VL(0.1362)	M(0.5)	4.560884
(55)	VL(0.1362)	L(0.2272)	VL(0.1362)	VL(0.1362)	VL(0.1362)	2.40245
(56)	L(0.2272)	L(0.2272)	SL(0.3695)	L(0.2272)	L(0.2272)	3.641372
(57)	VL(0.1362)	SL(0.3695)	SH(.6304)	VL(0.1362)	VL(0.1362)	3.775023

Because of limited space, the column of Nominal capacity was ignored to appear in this table.

Table 5 displays the hierarchical cluster classification of 57 FMPI based on obtained values and 5 criteria including the number of employees, power, water and fuel consumptions and land area values. A hierarchical cluster classification was developed for FMPI according to Table 5 as Cream dyed (42) > Dates and liquid sugar (43) > Soya sauce (51) > Margarine (14) > Corn grits (31) > Non-alcoholic Beer (1) > Purification and packaging of salt (41) > Compote (7) > Canned fish (tuna) (4) > Ketchup (52) > Alcohol from beet molasses (23) = Wheat flour (25) > Milk, yogurt and pasteurized cream (15) > Canned meat (5) > Potato based foods (17) > Iodinized salt (19) > Canned Beans and Caviar Eggplant (3) > Fish food (11) > Cheese from fresh milk (35) > Mushroom cultivation (34) > Olive oil (47) > Oil Seeds from Vegetable Seeds (except soya; olive) (48) > Tomato paste (45) > Soya protein (33) > Raisin Packaging (54) > Date sap (16) > Food sauces (53) > Starch from wheat (20) > Drying oils (49) > Corn Flakes (9) > Fruit packaging (29) > Artificial sausage and sausage coating (39) > Canned mushrooms (6) > Glucose from starch (12) = Dried vegetables (50) > Poultry slaughterhouse (18) > Ice (57) > Sausage (56) > Treating fish (21) > Fish powder (38) > Mineral water (24) > Cake and muffins (2) > Pizza Cheese (36) > Flour string (46) > Meat and Olive Industrial Powder (37) > Concentrated fructose syrup of corn sugar (8) = Pistachio packaging (26) > Wafer biscuits (30) > Biscuit (32) > Packing grains; peeling off barley (27) > Preparation; packaging of honey (40) > Dates packaging (55) > Wafer chocolate (22) > Smoked fish (44) > Industrial Bread (10) = Hamburger (13) = Spice Packing (28). Tables 6 and 7 represent the Kendall's W and Friedman tests results and model summary of Mean Cronbach's Alpha respectively.

The distributions of employees, power, water, fuel, and land values were obtained normally with mean and standard deviation of around 33.40 and 19.56, 225.88 and 257.47, 28.53 and 29.27, 1105.46 and 7988.8, 5740.35 and 3875.65 by Null Hypothesis respectively. The t-test analysis had shown no significant difference among criteria. In the following, present values were obtained around 0.119 (Null hypothesis was retained), 0.001, 0.020, 0.000 (Null hypothesis was rejected for these three values) and 0.163 (Null hypothesis was retained) respectively. The sequence of values defined by employees, power, water, fuel, and land criteria was reported to be about ≤ 29, 164, 19, 31 and 4800 as the values higher than aforementioned amounts, were random respectively. Therefore, the one sample runs tests were offered the amounts around 0.516, 0.230, 0.142, 0.895 and 0.690 for employees, power, water, fuel, and land by Null Hypothesis respectively. As a result, the Null Hypothesis was retained. The related samples of Friedman's Two-way analysis of variance by ranks were revealed no significant difference among criteria pertaining on the Null Hypothesis while the distributions of employees, power, water, fuel and land criteria were obtained same. Therefore, the Null Hypothesis was rejected.

4. Discussion

Figure 2, Tables 2 and 3 were included the flow-diagram of existing and running technologies, input materials stream and the number of staff, land area used and energy consumption for each industry. It has a worth to mention that classification and aggregation of manufacturing data are vital for analyzing economic activity and totally sustainable development purposes. Iranian industries are encouraging to select practices and approaches to decline production outlays, promote products quality and escalate productivity etc. By the way, we can notice to some prominent practical applications of present research such as possibility of display the spectrum of existing and potential growth rates via data envelopment analysis, feasibility in compare Iranian industries availability with industries of other nations, employing available data as a universal reference in this regard, paving the way for simplicity in economic estimation practices of industries and providing the energy resources consumptions (water, electricity, and fossil fuel). The difficulties posed in developing industrial ecology refer to both materials and energy stream networks and bereavement of a useful database to design and execute materials and energy stream networks among industries. Our data were collected from the initial screening of the evaluator team of both IIO and IEPA once before the establishment of each industry. The studies associated with questionnaire methods need to figure out the compatibility of data. Hence, using a special vector, the natural attribution of the data incompatibility can be calculated via equation 11 in the matrix.

λmax (The biggest eigenvalue of the pairwise comparison) for an invertible matrix is always greater than or equal to the criteria number (m), and this value will be equal to m for a matrix. In this way λ max-m is a reasonable measure of incompatibility degree of a matrix. Saaty (1980) compared the Consistency Index (CI) with a Random Index (RI) and then revealed that RI for various quantities of m; generated based on random matrices of A and by computing the average of CI within the matrices. RI is the random index obtained from a table designed by Saaty for a matrix with rows going from 1 to 10. According to the description of the Saaty if CR ≤ 0.1; (equation 12) the matrix compatibility is accepted (11).

$$\mathrm{CI} = \frac{\lambda \max - m}{m - 1} \qquad (11)$$

$$\mathrm{CR} = \frac{\mathrm{CI}}{\mathrm{RI}} \qquad (12)$$

Table 6. Kendall's W and Friedman tests results

N	57
Kendall's W[a]	.793
Chi-Square	180.749
df	4
Asymp. Sig.	.000
Mean Ranks	
Employee	2.17
Power	3.95
Water	1.64
Fuel	2.26
Land	4.98

a. Kendall's Coefficient of Concordance

The SAW method supported by the Friedman test (Table 5) has resulted in a simple classification of FMPI according to Table 5. By the way, the Likert scale (in Table 4) was used to set up the decision matrix in the Fuzzy system and then it was finalized by weighing values.

Table 7. Model summary of Mean Cronbach's Alpha

Dimension	Cronbach's Alpha	Variance Accounted For		
		Total (Eigenvalue)	Inertia	% of Variance
1	1.000	5.000	1.000	99.999
2	1.000	4.996	.999	99.929
Total		9.996	1.999	
Mean	1.000[a]	4.998	1.000	99.964

a. Mean Cronbach's Alpha is based on the mean Eigenvalue.

The reliability of the questionnaire depends on a statistical test that results in a coefficient called the Cronbach's Alpha. To figure out the reliability of existing values was used the Mean Cronbach's Alpha according to Table 7. Cronbach's Alpha rule of thumb is defined as $\alpha \geq 0.9$ (excellent), $0.8 \leq \alpha < 0.9$ (good), $0.7 \leq \alpha < 0.8$ (acceptable), $0.6 \leq \alpha < 0.7$ (questionable), $0.5 \leq \alpha < 0.6$ (poor), $\alpha < 0.5$ (unacceptable). The Mean Cronbach's Alpha based on the mean Eigenvalue was obtained about 1.

In our previous study revealed the significant differences between power-water and fuel-land; among parameters such as initial feed, employees, power, water, fuel, and land for 6 types of Iranian recycling industries ($p \leq 0.016$ and 0.023) using SPSS analysis respectively (13). Tash and Nasrabadi (14) achieved to classify and rank the Iranian monopolistic industries via SPSS analysis. Shaverdi et al. (15) accomplished a Fuzzy Analytical Hierarchy Process (AHP) to develop and mature sustainability for the publishing industry. So, it was acquired ranking values among factors. Shaverdi et al (16) developed a ranking classification based on Fuzzy AHP approach among Iranian petrochemical sectors in order to evaluate financial performance. Hourali et al (17) used Minitab and SPSS Soft-wares to assess 45 Iranian Small and Medium Enterprises (SMEs) to develop a model for E-Readiness. Obtained values resulted in weighting indicators. Hosseininia and Ramezani (18) used SPSS analysis to assess the sustainable performance of around 12 SMEs by participating 130 managers in Iranian food industries which resulted to place both factors of social and environmental in the highest level. Behrouzi et al (19) classified and ranked the options and obtained average weights to lean supply chain performance measurement of SMEs among 133 automotive industries using Fuzzy Multi Attribute Decision Making along with SPSS analysis. Dadashpoor and Allan (20) performed a study to Intra-metropolitan supply linkages, industrial clustering and driving forces in the Iranian automotive sector by SPSS analysis. So obtained results lead to figuring out the weak evidence of industrial clustering. Salehi and Hematfar (21) found significant relationships between accounting variables of industrial chemical companies listed on the Tehran Stock Exchange in 10 models using SPSS analysis from 2005 to 2010. Kavousi and Salamzadeh (22) weighted and prioritized indicators influencing the success of a strategic planning process among National Iranian Copper Industries, via Cochran formula plus Shannon's method and Topsis technique. Yunus et al. (23) in order to evaluate statistical process control towards process efficiency, used the SPSS analysis among Iranian food industries. By the way, results revealed a relevant quality improvement, food safety, and security at an open global market. Radfar and Ebrahimi (24) found the priority in order to invest, methods in technology transfer by Fuzzy MCDM among Iranian shipping industries. Obtained results presented that both joint venture and the subsidiary companies were the highest and lowest priorities, respectively. Moghimi et al. (25) assigned Fuzzy MCDM approach to do a survey based on financial performance among 8 Iranian cement companies listed in the Tehran Stock Exchange. By the way, it was found that the performance ranking of Sabhan, Sarab, Sedasht, Safar, Sekaroun, Sakarma, Sanir and Sahrmoz companies with priority scores of around 0.55, 0.51, 0.50, 0.49, 0.42, 0.37, 0.36 and 0.33 respectively. Fekri et al (26) studied main items affecting the agile new product process and the connections between them by Fuzzy cognitive map procedure among Iranian manufacturing enterprises. So, they have classified and sorted into 6 main groups and the connections tabulated.

5. Conclusion

Present study collected all information associated with the input materials stream introduced into industries, the amounts of output products and energy consumed etc at FMPI. The industries were ranked and prioritized based on 5 factors and for each industry was depicted running flow-diagrams individually. The existing data can be exploited in further studies.

Conflict of interest

There is no conflict of interest.

Acknowledgements

This research was conducted as part of corresponding author PhD research work.

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