

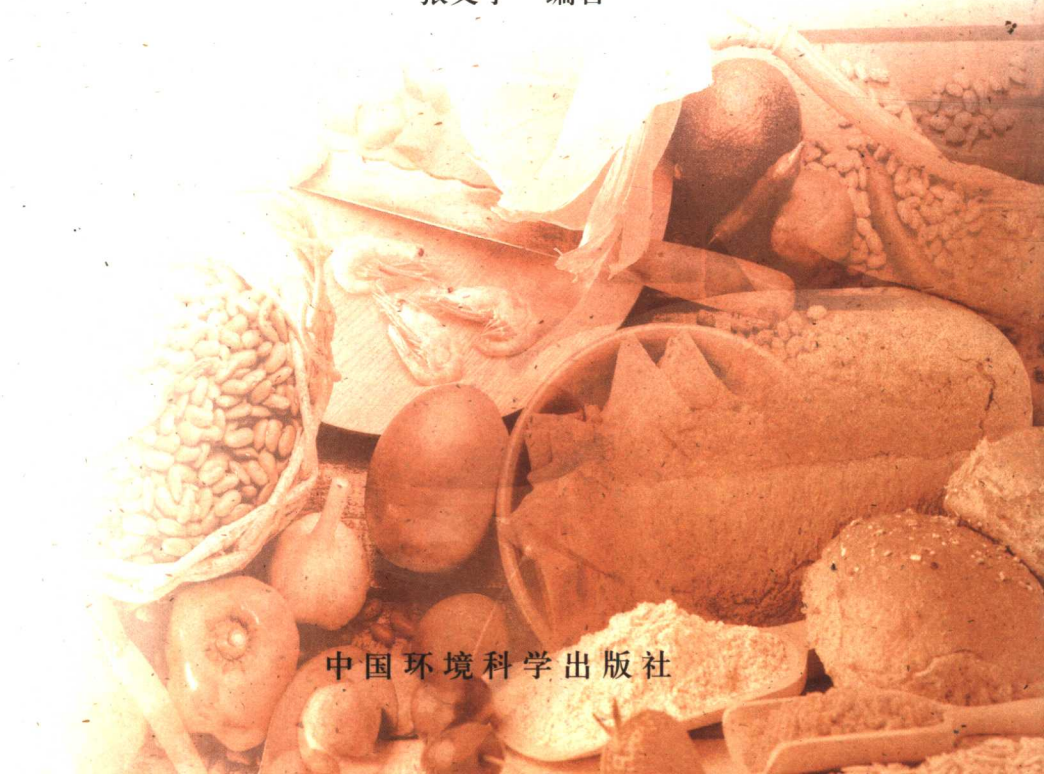
环 境 博 士 文 库

# 食 品 安 全 环 境 管 理

ENVIRONMENTAL MANAGEMENT  
OF FOOD SAFETY

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中国环境科学出版社



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## 摘 要

### 1. 命题释要

#### (1) 环境与现代食品安全问题

持续有效地获取食物是保障人类生存与发展的最基本前提, 科技进步和经济发展一方面使人类获取食物的能力不断增强、手段更加先进, 进而食品供应随之更加丰足; 另一方面, 与经济发展相伴随的环境污染及与现代食品生产技术相关的环境因素(如农药施用等)已成为威胁食品安全的主要原因之一。环境污染物不仅构成现代食品安全问题的六大类别之一, 而且其他类别几乎也直接或间接与环境污染等环境因素相关(表 1-1)。因此, 研究和解决食品安全环境影响问题已迫在眉睫。

#### (2) 必要的定义

- 食品。在本书中具有泛指性、广义性和资源形态性, 与“食物”具有等同含义。广义的食品指以原状或经过加工后能供人类食用, 或通过其他方式吸收, 以各种形态存在的物品。书中在对食品生命周期存在形态进行划分时, 把生成食品的环境要素(土壤、水体、生物等)视为食品的资源物质形态。

- 食品安全。食品安全具有双重定义, 即食品量安全(Food Security)和食品质量安全(Food Safety), 本书的研究范畴界定为食品质量安全, 即一般观念上的公众理解的“食品安全”。

- 环境。环境是一个常用而又复杂的概念, 在不同的学科中或特定范围内有不同的定义。本书所指“环境”首先属自然环境范畴, 并特指自然环境中构成食品自然物质基础的环境要素, 以及环境要素质量变化(如环境污染、污染行为及环境污染因子等)。因此, 书中“环境”概念包涵环境污染、环境要素、环境因素等含义。

#### (3) 研究范围

本书是在环境问题的范畴内研究食品安全问题的产生及解决方法。食品安全环境影响问题在宏观上可以被视为环境污染等环境问

题在食品安全性上的后果表现,中观上则表现为食品生产过程中发生的环境污染与食品生产的矛盾冲突,微观上表现为环境污染物在食品中的存在——环境对食品安全影响的最终表现。

#### (4) 研究内容与目标

本书的研究内容主要包括:①食品安全与环境的关系特征表现;②食品安全环境影响范围(责任)界定;③食品安全环境影响的物质代谢原理;④食品安全环境问题产生的经济学原理;⑤食品安全环境管理政策安排;⑥食品安全环境管理体系设计(包括环境管理在食品安全体系中的安排)。总体上,通过研究实现系统地、全面地认识食品安全环境影响问题产生的本质原因及问题解决的政策方法,以及探索食品安全环境管理理论体系建立的研究目标。

#### (5) 研究方法和研究思路

考虑到食品安全环境影响问题的学科交叉性和问题表现的技术特征,首先运用系统分析和抽象归纳方法对问题表征及其属性进行研究。在此基础上,运用物质代谢原理和污染生态学原理对环境污染物在食物链中的迁移进行了分析,以论证环境因素对食品安全影响的自然规律。其次,运用经济学思想,特别是环境经济学原理对食品安全环境影响问题的原因进行了剖析,为食品安全环境管理提供依据。再次,在上述研究结果基础上,借助环境管理学和环境政策学理论体系指导研究食品安全环境管理政策安排和体系设计。

### 2. 食品安全与环境:关系要素及责任界定

环境污染(因素)对食品安全性的影响问题已成为不争的事实,但人们对该问题的认识往往停留在“现象”上和特定的表征上。为了全面地、深入地认识环境对食品安全的影响问题,并为问题研究和解决的需要,必须归纳两者之间的关系、抽象出问题的本质属性、界定问题的外延和内涵。

#### (1) 食品安全与环境的关系要素

食品安全性是食品的基本功能特性之一。因此,食品安全与环境的关系首先反映在食品与环境的关系上。食品与环境第一关系层次表现为作为主体的人类与环境之间的最基本物质交换关系,即人

类必须从环境中获取足够的食物来维持人体的发育、成长和遗传等活动；第二关系层次表现为人类获取食物的方式。由于纯自然的食品生产方式远远不能满足人类对食品量的需求，人类必须并且已经建立起具有经济属性的现代食品生产体系，这种体系以物质和技术投入为标志，具有更高的生产效率，使食品与环境关系超越了纯自然体系下的物质交换关系（图 2-1）。

其次，食品安全与环境的关系反映在人类食物链上。人类现代食品生产体系的建立使原始人类赖以生存的自然食物链演化为今天由自然链和人工链组成的复杂食物网，形成现代人类食物链（图 2-2）。这种食物链的复杂性和开放性使得环境污染物进入食品而影响食品安全和人体健康。

再次，食品安全与环境的关系表现在食品的生产、加工、流通过程。本文提出了食品生命周期链概念，并将食品的生命周期分为五种形态，即自然环境形态、要素形态、原料形态、产品形态和商品形态。食品在五种形态之间的存在环境分为四种：①食品资源环境。②食品生产环境。③食品加工环境。④食品流通环境。存在于各种环境中的环境污染物及环境条件分别以不同方式和强度影响食品的安全性。

最后，食品安全与环境的关系表现为环境污染物在食品中的存在性。本书对食品在各种存在环境中的污染物及食品中的主要环境污染物进行了初步分析和分类。

## （2）食品安全的环境责任界定

环境污染（因素）对食品安全的影响作为业已存在的普遍性问题，仅从关系特性和技术表征的角度或分别从单个的环境因素进行认识是不够的，也不利于问题的研究和解决。从而有必要抽象出问题的本质，把食品安全环境影响作为一个独立的范畴加以考察和明确。为此本书提出了“食品安全的环境责任”概念。由于未见相关研究报道，本书探索性地对此概念作了外延和内涵界定，并对食品安全的环境责任进行了层次划分。

食品安全环境责任的外延。外延界定需要一个“边界”作为参

照, 鉴于食品的生命周期链(图 2-5)比较完整地反映了食品的各种形态及其转化过程, 因此, 选择食品生命周期链作为参照系。本书把食品安全的环境责任界定为资源环境责任和生产环境责任两大方面, 即将食品从自然环境资源经改造成为食品生产环境要素(农用地、灌溉水体、食品生物等), 再经过动植物生产转化为原料形态过程中发生的影响食品安全的环境因素归为食品安全的环境责任范畴。换句话说, 环境应对食品在脱离生产环境之前承担安全责任。而将加工过程和流通过程中的环境影响排除在外, 这是因为这个过程中的食品安全主要责任是卫生管理责任。食品安全环境责任外延的界定为研究解决食品安全环境影响问题提供了明确的概念和范围。相应地, 食品安全环境管理对象和范围也因此而界定。

食品安全环境责任的内涵。食品安全环境责任的内涵指在责任的范围内有哪些环境污染行为和环境因子对食品安全产生具体作用。主要包括: 环境层面的环境污染对食品生产环境质量的间接影响、污染排放对食品生产环境质量的直接影响和人工投入环境因子(农药、化肥等)对食品的直接污染和作为污染因子对生产环境的污染。

食品安全环境责任的层次划分。环境对食品安全的影响是一个过程系统, 并且是经过演变最终导致对食品安全的危害。同时, 环境问题本身存在时间和空间上的层次性。基于此, 本书将食品安全的环境责任分为三个层次: ①环境层次。环境层次实际上是指宏观的或国家层面上的环境现状对食品安全的影响; ②要素层次。即食品生产要素环境层次, 特指直接作为食品生产要素的环境要素, 如农用地、农用水体以及产区大气污染等对食品安全的影响; ③技术层次。主要指人工投入环境因子(如农药、化肥等)在发挥其生产促进功能的同时, 对食品安全的影响。食品安全环境责任的划分为食品安全环境管理政策安排、制定和实施提供了明确的范围和对对象。本书关于食品安全环境影响及环境管理政策研究也据此而展开。

### 3. 食品安全环境影响的理论分析

在明确了食品安全环境影响问题的特征、范围和属性之后,

本书对问题的产生进行了理论分析,从而提升到对问题本质的认识,为问题的解决寻找理论依据。研究针对食品安全环境责任的三个层次,主要运用环境经济学方法并辅助于自然的物质代谢原理展开分析。

### (1) 食品安全环境影响的自然原理

书中首次提出了食品形成过程中物质代谢的无差异性论点,即认为包括环境污染物在内的各种物质在自然界的物质代谢过程中并无性质上的差异,从而证明环境污染物在食品中存在的必然后果。同时,运用污染生态学原理和环境污染物在食物中的动态迁移原理对环境污染物进入食品的过程进行了简要阐述。借此提出了保障食品安全的自然原则。

### (2) 食品安全环境影响的经济原理

主要透过环境问题产生的经济本质及经济发展水平与环境污染的关系演变,同时借助与经济发展相关的收入水平与食品可获得性的关系分析,研究食品安全问题在环境—经济系统中的生成与演变规律。提出了食品安全与经济发展关系演变假设曲线(图 3-6),研究结果认为:食品量安全保障是食品质量安全的前提,经济发展水平影响食品供应总量的保障,同时也影响个人及家庭的食品可获得能力。因此,经济发展水平不仅通过环境污染的技术途径影响食品的安全性,也通过其对食品可获得性间接地影响消费者对食品安全性的需求。所以,实现经济、环境的可持续发展是在宏观层次上消除环境污染对食品安全影响的前提。

### (3) 食品安全问题产生的环境经济学原理

本书以食品生产环境要素的双重功能(作为生产要素和作为公共物品属性的环境要素)分析为前提,运用外部性理论对环境污染影响食品安全的内在机理进行了分析。首先,食品生产环境要素作为环境污染物排放对象而成为环境污染外部性的受害者;其次,由于缺乏有效的控制和监督,使得食品生产者以私人成本生产受到环境污染影响的不安全食品,而将食品安全成本转移给社会和消费者,形成食品安全环境影响的内在原因。食品安全环境管理的主要

任务就是要通过制定和实施有效的环境经济政策和采用相关的法规及市场手段阻止食品安全成本的对外转移,从而消除或减少在环境要素层次及技术层次上的食品安全环境影响。据此,本书提出了保障食品安全的环境经济政策要旨。对食品安全价值损失评估、食品生产环境污染赔偿和化肥、农药外部成本内部化作了粗略分析。

#### 4. 食品安全环境管理政策安排与体系设计

在问题特征和问题原理研究的基础上,本书对问题的解决途径和方法进行了研究。主要体现为食品安全环境管理的体系设计和管理政策安排。

##### (1) 食品安全环境管理体系设计

作为一个新的命题,本书对相关概念及食品安全环境管理的概念要素进行了明确,然后,对食品安全环境管理的政策手段、政策安排、政策结构进行了阐述。在此基础上,提出了食品安全环境管理政策体系的基本构造,并对有关的具体的政策内容作了简单的分析。

(2) 由于环境管理特别是食品安全问题具有明显的技术特征,食品安全环境管理离开不了技术的支持,因此,本书对食品安全环境管理技术支持体系进行了研究,并提出了其基本构造(图 5-4),同时对其内容进行了阐述。

(3) 本书从系统的角度并运用本文的研究结果对现行的食品安全体系进行了考察和评价,认为现行的食品安全体系存在观念上和措施上的局限性,即现行食品安全体系只强调运用“基本科学”的技术分析和技术手段方面保证食品在进入人体时的终端安全,弱化甚至回避了食品安全环境影响的源原因。因此,本书的研究认为:完整的食品安全保障体系必须是由环境管理参与的,从食品资源环境、生产环境(农田)到消费终端(餐桌)的全程安全保障(图 5-10)。

#### 5. 构建我国食品安全环境管理体系

本文在理论研究的基础上,对我国食品安全环境影响及管理现状进行了评价,并提出了我国食品安全环境管理体系框架及政策建议。

(1) 我国的食品安全环境影响问题特征上表现为问题的凸现与环境底数不清的困惑, 污染因子以农药、化肥残留为主, 食品生产环境污染也比较严重; 管理上表现为体制、法规、标准不健全以及技术支持体系不完善等。

(2) 本文对保障我国食品安全的政策结构及主要的政策内容进行阐述, 并提出了构成我国食品安全环境管理技术支持的主要内容。

(3) 文章建议: 宏观上, 在满足我国食品可持续量保障的前提下, 应注重食品资源环境质量管理; 环境要素层次上, 运用法律、行政及环境经济手段控制对食品产区环境的污染排放; 在环境因子层次上, 尽快制定农药、化肥环境安全法规和管理运用经济政策的手段控制和减少农药、化肥的施用量。

最后, 在以“三绿工程”为案例的分析基础上, 提出了我国食品安全管理体系组织机构设计。

## 6. 本书的主要创新与不足

食品安全环境管理研究命题本身具有一定的创新意义和挑战性, 本书力求从环境的视角全面地、系统地考察和研究食品安全问题, 得出食品安全环境影响问题及食品安全环境管理的研究及实际工作框架。总体上具有理论上的独创性和现实意义, 具体创新包括: ①对食品安全与环境的关系与问题的界定, 提出了食品安全环境责任概念, 把对食品安全环境影响问题的认识从观念、技术上的判断上升到理论抽象的高度; ②首次运用环境经济学方法分析食品安全环境影响问题的产生机理, 找出了问题的本质; ③提出了食品安全环境管理体系(包括政策体系和支持体系)框架, 得出了建立由环境管理参与的完整的食品安全体系。

本书的不足之处主要表现为缺乏定量分析作为支持, 技术分析与经济分析的结合也不够紧密。尚待进一步完善研究的问题还很多。

## **Abstract**

### **1. Brief explanation of proposition**

#### **(1) Environment and the problem of modern food safety**

It is the most essential prerequisite for guaranteeing human survival and development to gain food continuously and effectively. On the one hand, progress of science and technology as well as economic development persistently strengthen human's ability of gaining food and made human's means of gaining food more advanced so that supply of food is more sufficient; on the other hand, environmental pollution that accompanies economic development and environmental factor concerning modern food production technology (e.g. using pesticides) has become one of main factors threatening food safety. Not only environmental pollutants are one of six categories of modern food safety problems but also other categories of problems directly or indirectly relate to the environmental factors such as environmental pollution (Table 1-1). Therefore it is extremely urgent to research and solve problems of environmental impact on food safety.

#### **(2) Necessary definitions**

- Food: In this paper, it is characterized by general reference, broad sense and resource morphology, meaning of which is same as that of "edible". Generalized food means matters that are ate by human or absorbed through other modes, which are crude or processed with various formations. When life cycle and existence formations of food are divided in the paper, environmental essentials (soil, water bodies and creatures) of producing food are taken resource material forms of food.

- Food safety: This expression has double meanings, i.e. Food Security and Food Safety. Research category of this paper is defined as Food Safety, i.e. "Food Safety" that is general and understood by the

public.

- **Environment:** It is a common and complicated concept, definition of which is different in different fields of learning and the special scopes. In this paper, “environment” firstly belongs to category of natural environment, especially refers to environmental essentials that form the natural material base of food in natural environment and their quality changes (such as environmental pollution, pollution actions and factors of environmental pollution). Therefore “environment” concept in this paper includes meanings such as environmental pollution, environmental essentials and environmental factors.

### (3) Scope of the study

This paper studies producing of food safety problem and its solving methods in the category of environment problem. Macroscopically the problem of environmental impact on food safety can be taken as the consequence of environment problems such as environmental pollution on food safety, generally appears as conflict between environmental pollution occurring in the process of food production and food production and microscopically is manifested by that environmental pollutant exist in the food — the final expression of the impact of environment on food safety.

### (4) Contents and objectives of the study

Study contents of this paper mainly include: ① Characteristic expression of the relation between food safety and environment. ② Definition of the scope of environmental impact (responsibility) on food safety. ③ material metabolizing principles of environmental impact on food safety. ④ Economic principles of producing the problem of environmental impact on food safety. ⑤ Management policy arrangement of environmental impact on food safety. ⑥ Management system design of environmental impact on food safety (including arrangement of environmental management in the

environmental impact on food safety system) . In general, essential causes of producing solving them as well as the study objectives established for exploring theoretical system of environmental management on food safety are systemically and roundly are recognized through research.

#### (5) Study methods and train of thought

With consideration of crossover of the fields of the learning of environmental impact problems on food safety and the technical characteristics shown by the problems, sacrificial characteristics of the problems and their attributes are firstly studied with the methods of systemic analysis and abstract induction and then transferring of environmental pollutants in the food chain is analyzed by means of the principle of material metabolizing and ecological principle of pollution on the fore-mentioned study to discuss the natural law of the impact of environmental factory on food safety. Secondly, causes of producing environmental impact problems on food safety are analyzed by means of economics thought, especially principle of environmental economic to provide the basis for environmental management on food safety. Finally, on the base of the above-mentioned study result, policy arrangement and system design of environmental management on food safety are guided and studied with help of the theoretic system of science of environmental management and the study of environmental policy.

### **2. Food safety and environment: Defining impact essentials and responsibility**

It is an undoubted fact that the environmental pollution (factor) has impacts on food safety. However, the understanding of this problem from some people is also staying on the phenomena and the specific signs. In order to understand the impacts on food safety from the environment deeply in all round way and to solve the problems, it is necessary to draw the relations between environment and food safety,

abstract the nature property and define the denotation and intension of the problems.

### (1) Relation factors of food safety and environment

Food safety is one of the basic function characteristics of food. Therefore, the relation between food safety and environment is firstly reflected on the relation between food and environment. The first relation level between food and environment appears as the most basic material exchange relation between the human as the subject and the environment, which means human must obtain enough food from the environment to maintain the activities such as growth, heredity of the human and so on. The second one appears as the way in which human obtains the food. Since the purely-natural food production mode cannot meet the demand on food quantity by human by far, human must and has established modern food production system with economic property, which, taking contribution of materials and technology as the sign, has higher production efficiency to made the relation between food and environment exceed the material exchange relation in the purely-natural system. (See figure 2-1) .

Secondly, the relation between food safety and environment is reflected on the food chain of human. The establishment of modern food production system for human has made the natural food chain, on which the primitive man relies, develop into the current complicated food network that is composed of natural chain and artificial chain to form the modern human food chain (figure 2-2) . The complication and open characteristics of this food chain make the environmental pollutants into the food so as to have impacts on the food safety and health of human.

Thirdly, the relation between food safety and environment is reflected on the process of producing, processing and circulating of food. This paper puts forward the concept of food life cycle and classifies it into five states, namely natural environment state, essential state, raw

material state, product state and goods state. The existence environment of the food among five states can be classified into four kinds: ① food resource environment; ② food production environment; ③ food processing environment; and ④ food circulating environment. The environmental pollutants existing in various environments and the environmental conditions have impacted the food safety in various ways and densities.

Finally, the relation between food safety and environment is shown as the existence of environmental pollutants in food. This paper gives initial analysis and classification to the pollutants in foods in various existence environments and main environmental pollutants in food.

## (2) Defining environmental responsibility of food safety

As a popular problem always existing, it is not enough to understand the impacts environmental pollution of on food safety from the viewpoint of relation characteristics and technical denotation or from the separate environmental factor, because it is not in favor of researching and solving problem. So it is necessary to abstract the nature of the problem, investigate and learn the environmental impacts on food safety as a separate category. Therefore, this paper puts forward the concept of environmental responsibility on food safety. Since the related research report has not been found, this paper tries defining the extension and intension of this concept and classifies the environmental responsibility on food safety in layers.

Extension of environmental responsibility on food safety: It is necessary to find a "boundary" as a reference for defining the extension. Because the life cycle chain of food (figure 2-5) reflects the various states of food and their conversion processes more completely, this paper takes the life cycle chain of food as the frame of reference. This paper defines the environmental responsibility on food safety as two aspects: environmental responsibility of resource and environmental

responsibility of production, i.e. food is upgraded to the environmental essentials (agricultural land, irrigation water body, food biology, etc) of food production from naturally environmental resource, and then it is classified into the category of environmental responsibility on food safety through environmental factors impacting food safety that occur in the process turning animal and plant production into raw materials forms. In other words, the environment shall be responsible for the safety before food is separated from production environment. It is because the main responsibility of food safety in this process is sanitation management responsibility that we exclude the environmental impacts in processing and exchanging process. The definition of the extension of environmental responsibility on food safety provides specific concept and range for researching and solving environmental management on food safety are also defined.

**Intension of environmental responsibility on food safety:** The intension of environmental responsibility on food safety means what environmental pollution actions and environmental factors in the range of responsibility will have concrete impacts on food safety, it mainly includes: the indirect impacts on environmental quality of food production from environmental pollution at the environment level, the direct impacts on environmental quality of food production from the discharged pollutants and the direct impacts on food from the environmental factors (farm chemical, fertilizer and so on) used by human as well as the pollution of production environment as the pollutants.

**Determine the level of environmental responsibility on food safety:** The impacts of the environment on food safety are a process system and it will lead to the harm to food safety finally through evolvement. At the save time, the environmental problems have the levels of time and space. Based on this, this paper divides the environmental responsibility on

food safety into three levels: ① Environment level, which in fact means the impacts on food safety from macro present situation of environment or the one at state-level; ② Factor level, i.e. the environmental level of food production factors, specially refer to the environmental factors as food production factors directly, such as the impacts on food safety from agricultural lands, agricultural water body and atmospheric pollution in the production area and so on; ③ Technical level, it mainly refers to the impacts on food safety from the environmental factors (e.g. pesticides, chemical fertilizer and so on) used by human when they make use of the functions of promoting production. The division of environmental responsibility on food safety provides specific range and object for arranging, establishing and carrying out the environmental management policy on food safety. This paper develops the research on environmental impacts and environmental management policy about food safety hereby.

### **3. Theoretical analysis of environmental impacts on food safety**

After defining the characteristics, range and property of environmental impacts on food safety, this paper analyzes the production of the problems theoretically, as a result it advances the understanding of the nature of the problems and provides theoretical basis for solving the problems. According to the three levels of environmental responsibility on food safety, this study performs analysis with the method of environmental economics as well as the principle of natural metabolism.

#### **(1) Natural principle of environmental impacts on food safety**

This paper firstly puts forward the proposition of non-difference of material metabolism in food forming process, i.e. holding that there are no characteristic differences among various materials including environmental pollutants in the material metabolism in the nature, thus proving the inevitable consequences that the environmental pollutants exist in the food. At the same time, it briefly articulates the process of

environmental pollutants entering the food with the principle of pollution ecology and the principle of dynamic migration in food of the environmental pollutants. On this basis, the natural principle of guaranteeing food safety is put forward.

## (2) Economic principle of environmental impacts on food safety

Mainly through the economic essential produced in environmental problem and the evolvement of the relation between economic development level and environmental pollution, with help of the analysis of the relation between income level and food obtainment relevant to economic development, this paper studies the production and evolvement rule in environment-economy system on food safety problem and puts forward the assumption curve of relation evolvement on food safety and economic development (Figure 3-6). The findings hold that the food security is the precondition of food safety and the economic development level not only affects the insurance of food supply quantity but also the food obtainment ability of individuals and families. Therefore, economic development level has impacts on the food safety through the technical way of environmental pollution as well as on the consumer's demand on food safety indirectly through the food obtainment. As a result, it is a precondition of eliminating the impacts on food safety from the environmental pollution at macro level to realize the sustainable development of economy and environment.

## (3) Environmental economics principle of producing food safety problem

At the premise of the analysis of the dual functions of environmental essentials on food production (as production factors and as the environmental factors of public product property), this paper analyzes the internal mechanism of environmental pollution impacting food safety with external theory. Firstly, environmental factors, as the discharged object of environmental pollutants, becomes the sufferer of