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An Application of the Flowchart Approach to the Agro-Food-Processing Industry Cluster in East Asia: The Case of the Nacala Corridor Region in Mozambique

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11.1 Introduction

Manufacturing industry cluster policies have been successfully implemented in East Asia, as shown by Kuchiki and Tsuji (2005). The possibility of applying the experience gained in East Asia to Africa has been examined. However, no industrial clusters, such as those observed in the Eastern Seaboard Region in Thailand and the southern China economic region, have been established in Africa. It has been difficult to introduce direct foreign investment, including automobile firms and their related suppliers, to Africa, and thereafter to agglomerate the firms.

Kuchiki and Tsuji (2008) constructed the flowchart approach to industrial cluster policy and established a model for the formation of an automobile industry as well as electric and electronics industry clusters in

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East Asia. This showed that the flowchart approach could be applied relatively easily to other regions.

The approach introduced a "time axis," in addition to geographical location, in spatial economics. The sequence of the efficient formation of the segments in a cluster is crucial to the success of industrial cluster policy. Here the segments, including roads, ports, electricity and so on, correspond to the investment environment for inviting direct foreign investment.

The purpose of this chapter is to examine whether we can establish an agro-food-processing industry cluster in Africa by using the flowchart approach constructed by Kuchiki and Tsuji (2008). The chapter will build a model of the flowchart approach to the agro-food-processing industry cluster by using the results obtained by Mizobe (2010) in the Nacala Corridor Region in Mozambique, which has one of the lowest incomes in the world.

In most African countries, agriculture is a key industry in generating employment opportunities, with the agricultural labor force representing more than 65 % of the total. It could be cutting edge to promote the development of agro-food-processing industry clusters in Africa.

Section 11.2 presents the prototype model of the flowchart approach to automobile industry cluster policy by showing the sequence of segment formation for industrial clusters. Section 11.3 compares the effects of forward and backward linkages using an international input–output table. Section 11.4 focuses on the effects of the agro-food-processing industry cluster. Section 11.5 presents a case study of an agro-food-processing industry cluster in Africa and proposes a model for such a cluster. Section 11.6 provides a summary and concludes.

11.2 A Prototype Model of Manufacturing Industry Cluster Policy

The purpose of this section is to explain our prototype model of the flowchart approach to manufacturing industry cluster policy and propose appropriate conditions for the success of an industrial cluster policy. That is, the flowchart can lead to the successful formation of an industrial cluster if the appropriate conditions set out in the flowchart are satisfied. Clustering consists of two main steps: Step I (agglomeration) and Step II (innovation), as explained in Chapter 1.

A simple version of Step I is illustrated in Fig. 11.1. First, we ask whether industrial zones have been established. If they have not been established, a decision should be made as to which actors should establish such zones. Once the actors are identified, we return to the main stream of the flowchart.

Next, the second part of Step I is segment building, which takes place after the establishment of industrial zones. We examine whether there is sufficient water supply for the industrial zones. We then proceed along the flowchart to examine whether the power supply, communication and transportation elements of the physical infrastructure are adequate.

After looking at the physical infrastructure, we examine whether appropriate institutions, laws and regulations are in place. The central

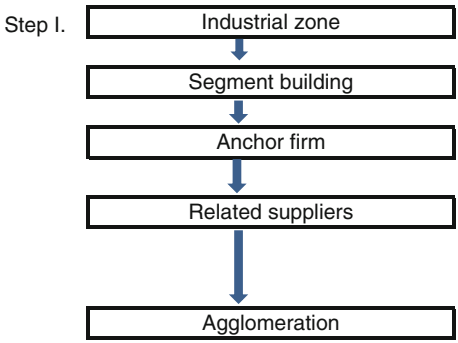

Fig. 11.1 Flowchart approach to the automobile industry cluster policy (*Source*: A. Kuchiki)

government must institutionalize national tax systems and the local government must institutionalize local tax systems for investors to invest in a timely manner.

In the area of human resource development, an abundance of unskilled labor with a high literacy rate is a necessary condition for inviting foreign investors into labor-intensive industries in East Asia. On the other hand, an industrial cluster sometimes faces a shortage of skilled labor after industrialization has progressed.

Living conditions, including entertainment facilities, international schools for children and an international-standard hospital, are crucial to attract foreign investors, and these conditions must be satisfied to bring in anchor firms. Here, an anchor firm is defined as one that "belongs to the manufacturing industry and has a high value of backward linkage in its input–output relationship."

11.3 A Comparison of the Effects of Industrial Linkages in East Asia and the USA

In 1973 the Institute of Developing Economies (IDE) in Japan launched an international input–output table for the Republic of Korea, the five ASEAN countries, the USA and Japan. In 1978 it began the construction of the 1975 multilateral input–output table for the ASEAN countries, Japan, the Republic of Korea (hereafter South Korea) and the USA. In addition, the Institute of Developing Economies - Japan External Trade organization compiled the 2000 Asian international input–output table on the linkage of Indonesia, Malaysia the Philippines, Singapore, Thailand, China, Taiwan, Korea, Japan and the USA.

Tables 11.1 and 11.2 show the effects of the industrial linkages of 24 sectors of the input–output table by country. The number of sectors in the industrial classification regarded as large is 7, with 24 regarded as medium and 76 regarded as basic. This chapter discusses the effects of the forward and backward linkages in the manufacturing and agriculture industries through the use of the input–output table for the 24 sectors regarded as medium, as shown in these tables.

Table 11.1 The average values of the effects of a forward linkage in ten economies

		Indonesia	Malaysia	Phillipinnes	Singapore	Thailand	China	Taiwan	South Korea	Japan	USA	Total average
1	Paddy	0.732	0.633	0.629	0.517	0.672	0.762	0.584	0.73	0.6	0.517	0.6371
2	Other agricultural products	0.902	0.896	0.741	0.567	0.92	1.263	0.8	0.59	0.62	1.009	0.8314
3	Livestock and poultry	0.609	0.721	0.606	0.519	0.628	0.771	0.803	0.68	0.64	0.787	0.6762
4	Forestry	0.698	0.8	0.556	0.517	0.559	0.698	0.521	0.58	0.65	0.838	0.6416
5	Fishery	0.564	0.61	0.559	0.519	0.642	0.626	0.673	0.57	0.58	0.524	0.5859
6	Crude petroleum and natural gas	1.813	1.158	0.519	0.517	0.81	1.274	0.559	0.52	0.52	1.071	0.8761
7	Other mining	1.096	0.61	0.662	0.558	0.637	1.074	0.605	0.62	0.59	0.723	0.7172
8	Food, beverages and tobacco	1.043	1.531	0.866	0.708	1.125	1.033	1.109	1.07	0.99	0.925	1.0397
9	Textile, leather and the products thereof	0.803	0.692	0.653	0.615	0.839	1.733	0.992	0.97	0.87	0.824	0.899
10	Timber and wooden products	0.675	0.734	0.602	0.577	0.6	0.72	0.564	0.68	0.69	0.755	0.6603
11	Pulp, paper and printing	0.822	0.789	0.641	0.639	0.766	0.992	0.898	1.07	1.36	1.195	0.9167
12	Petroleum and petro products	1.008	1.049	0.791	0.962	0.986	2.475	1.498	2.15	2.73	2.034	1.5685
13	Other manufacturing products	0.808	1.268	1.119	1.37	1.141	1.583	0.911	1.36	0.98	1.006	1.155
14	Rubber products	0.584	0.587	0.58	0.552	0.677	0.744	0.585	0.61	0.71	0.604	0.6226
15	Non-metallic mineral products	0.591	0.75	0.678	0.617	0.7	0.858	0.734	0.79	0.81	0.706	0.7233
16	Metal products	0.818	0.998	0.833	0.801	0.77	2.137	1.262	1.79	2.65	1.522	1.3579
17	Machinery	0.711	0.952	0.63	0.804	0.919	2.15	1.184	1.37	2.76	1.832	1.3312
18	Transport equipment	0.893	0.744	0.538	0.702	0.809	1.177	0.765	0.85	1.63	0.94	0.9048

(*continued*)

Table 11.1 (continued)

		Indonesia	Malaysia	Phillipinnes	Singapore	Thailand	China	Taiwan	South Korea	Japan	USA	Total average
19	Other manufacturing products	0.593	0.798	0.594	0.816	0.722	1.108	0.783	0.89	1.37	1.052	0.8726
20	Electricity, gas and water supply	0.737	0.908	1.072	0.629	1.09	1.778	0.67	1	1.22	1.001	1.0104
21	Construction	0.674	0.633	0.609	2.481	0.529	0.639	0.727	0.62	0.79	0.688	0.8383
22	Trade and transport	1.935	1.727	1.4	3.042	1.949	2.329	1.589	1.31	3.13	2.882	2.1289
23	Services	1.434	1.724	1.744	0.644	1.719	2.259	2.827	2.78	4.16	4.625	2.3911
24	Public administration	0.525	0.562	0.517	0.875	0.517	0.517	0.517	0.52	0.53	0.517	0.559

Source: A. Kuchiki based on IDE-JETRO

Table 11.2 The average values of the effects of forward and backward linkages

		Indonesia	Malaysia	Phillipinnes	Singapore	Thailand	China	Taiwan	South Korea	Japan	USA	Backward linkage	Backward linkage + forward linkage
1	Paddy	0.644	0.948	0.647	0.517	0.73	0.977	0.961	0.68	0.85	0.517	0.7469	0.692
2	Other agricultural products	0.678	0.765	0.693	1.142	0.768	0.957	0.863	0.78	0.84	0.975	0.8469	0.83915
3	Livestock and poultry	0.959	1.411	0.882	1.142	1.087	1.086	1.403	1.32	1.25	1.399	1.1941	0.93515
4	Forestry	0.677	0.729	0.681	0.517	0.662	0.833	0.956	0.7	0.79	0.968	0.7512	0.6964
5	Fishery	0.699	0.933	0.73	1.134	0.889	0.994	0.846	0.91	0.91	0.91	0.8952	0.74055
6	Crude petroleum and natural gas	0.637	0.694	0.761	0.517	0.753	0.904	0.634	0.52	0.85	0.822	0.709	0.79255
7	Other mining	0.707	0.897	0.811	1.062	0.802	1.165	0.779	0.83	1.04	0.934	0.903	0.8101
8	Food, beverages and tobacco	1.019	1.282	1.017	1.197	1.112	1.235	1.29	1.2	1.07	1.184	1.1606	**1.10015**
9	Textile, leather and the products thereof	1.07	1.217	1.013	1.093	1.168	1.426	1.278	1.23	1.12	1.124	1.1738	0.91705
10	Timber and wooden products	1.019	1.093	0.98	1.19	0.905	1.411	0.936	1.11	1.08	1.09	1.0812	0.87075
11	Pulp, paper and printing	0.934	1.12	0.943	1.023	0.986	1.277	1.031	1.22	1.07	1.001	1.0598	0.98825
12	Petroleum and petro products	0.944	1.234	1.067	1.053	1.067	1.402	1.15	1.2	1.14	1.053	1.1308	0.98825
13	Other manufacturing products	0.777	0.997	0.681	0.732	0.651	1.12	0.637	0.67	0.66	1.076	0.7999	1.34965
14	Rubber products	0.987	1.116	1.078	1.155	1.114	1.415	1.096	1.13	1.12	1.048	1.1264	0.8745

(*continued*)

Table 11.2 (continued)

		Indonesia	Malaysia	Phillipinnes	Singapore	Thailand	China	Taiwan	South Korea	Japan	USA	Backward linkage	Backward linkage + forward linkage
15	Non-metallic mineral products	0.942	1.106	1.107	1.118	0.997	1.368	0.987	1.11	1.04	0.973	1.0743	0.8988
16	Metal products	1.033	1.177	1.114	1.241	0.97	1.477	1.153	1.27	1.15	1.069	1.1651	1.2615
17	Machinery	1.041	1.263	1.134	1.257	1.2	1.45	1.256	1.21	1.17	1.016	1.1995	1.26535
18	Transport equipment	1.003	1.147	1.193	1.22	1.151	1.539	1.161	1.38	1.4	1.128	1.2315	1.06815
19	Other manufacturing products	1.048	1.105	1.004	1.107	1.062	1.435	1.203	1.26	1.16	1.003	1.1382	1.0054
20	Electricity, gas and water supply	1.009	0.838	1.008	0.947	0.91	1.206	0.54	0.84	0.88	0.952	0.9129	0.96165
21	Construction	1.019	1.139	0.874	1.116	1.093	1.434	1.115	1.09	1.04	1.032	1.095	0.96665
22	Trade and transport	0.829	0.796	0.832	0.93	0.8	1.137	0.711	0.81	0.8	0.843	0.8487	1.4888
23	Services	0.838	0.816	0.791	0.938	0.878	1.107	0.724	0.84	0.81	0.824	0.8563	1.6237
24	Public administration	0.794	0.956	0.743	0.977	1.092	1.154	0.75	0.79	0.78	0.837	0.8873	0.72315

Source: A. Kuchiki based on IDE-JETRO

The candidates for anchor firms are those in Sectors 8 (food, beverages and tobacco), 9 (textiles, leather and the products thereof), 17 (machinery) and 18 (transport equipment). The manufacturing industry with the highest value for the backward linkage effect is Sector 18 in Table 11.1. The subsectors of Sector 18 include automobiles, motorcycles and shipbuilding. The subsectors of Sector 17 include electric and electronic equipment, heavy electric equipment, metallic machines, general machines and so on. The subsectors of Sector 8 include food, milling and dairy products, and the subsectors of Sector 9 include yarn processing, fiber, sewing and apparel.

As shown in Table 11.1, the countries with a value of more than 1.0 for the forward linkage effect in Sector 8 are Malaysia, Thailand, Taiwan and South Korea. Sector 9 consists of China alone, while those in Sector 17 are China, Taiwan, South Korea and Japan, and those in Sector 18 are China and Japan.

As shown in Table 11.2, all of the countries in the table have a value of more than 1.0 for the backward linkage effect in Sector 8, with the average being 1.17. Again, all of the countries in Table 11.2 have a value of more than 1.0 for the effect in Sector 9, with the average being 1.19. All of the countries also have a value of more than 1.0 in Sector 18, with the average being 1.23.

The value of the total effects of the forward and backward linkages divided by 2 is shown in the last column in Table 11.2. The values in Sectors 22 (trade and transport) and 23 (services) are 1.488 and 1.623, respectively. These are the highest in the table. The values in Sectors 13 (petroleum and petro products), 17 (machinery), and 16 (metal products) are 1.34, 1.265 and 1.261, respectively. It can be concluded that the effect of Sector 8 is comparable to that of Sector 17 as the values of sectors 17 and 8 are 1.06 and 1.10, respectively.

11.4 A Focus on the Effects of the Agriculture and Food Industries Cluster

This section focuses on the strong effect of Sector 8 based on the results obtained in the previous section. It should be noted that the value of the effect of the backward linkage in Sector 3 (livestock and poultry) is large at 0.935. The agriculture industry includes both Sector 8 and Sector 3. In addition, it includes not only the industries associated with seeds, fertilizer, agricultural machines and equipment but also those associated with the tertiary industry of marketing and logistics as related to the process of trading agricultural products.

We found that the backward linkage effects are greater than those of forward linkage in most industries except those such as sector 22 and 23. Based on this, the flowchart approach to the agro-food-processing industry is proposed as shown in Fig. 11.2. The approach is a framework to promote and strengthen the effect of the backward and forward linkages between the agriculture, food-processing and services industries.

One point crucial to the success of industrial cluster policy when using the flowchart approach is finding an anchor firm to take on a leading role in regional development. The candidates for an anchor firm for the agriculture industry should be selected from the food industry because this has a high value for backward and forward linkage effects, as shown in the previous section.

An automobile is composed of more than 20,000 components. Anchor firms in the automobile industry need suppliers for the parts and components used in assembling cars to be located near their factories. It is a characteristic of developing countries that farmers are weak economically and usually have little ability to create capital in comparison with suppliers in the parts and components industry. As the food industry needs and depends on agricultural products for processing food as part of a primary industry, agriculture plays a key role in providing these materials. The location of the anchor firm factories in the food industry depends on the conditions related to the agricultural field ecosystem.

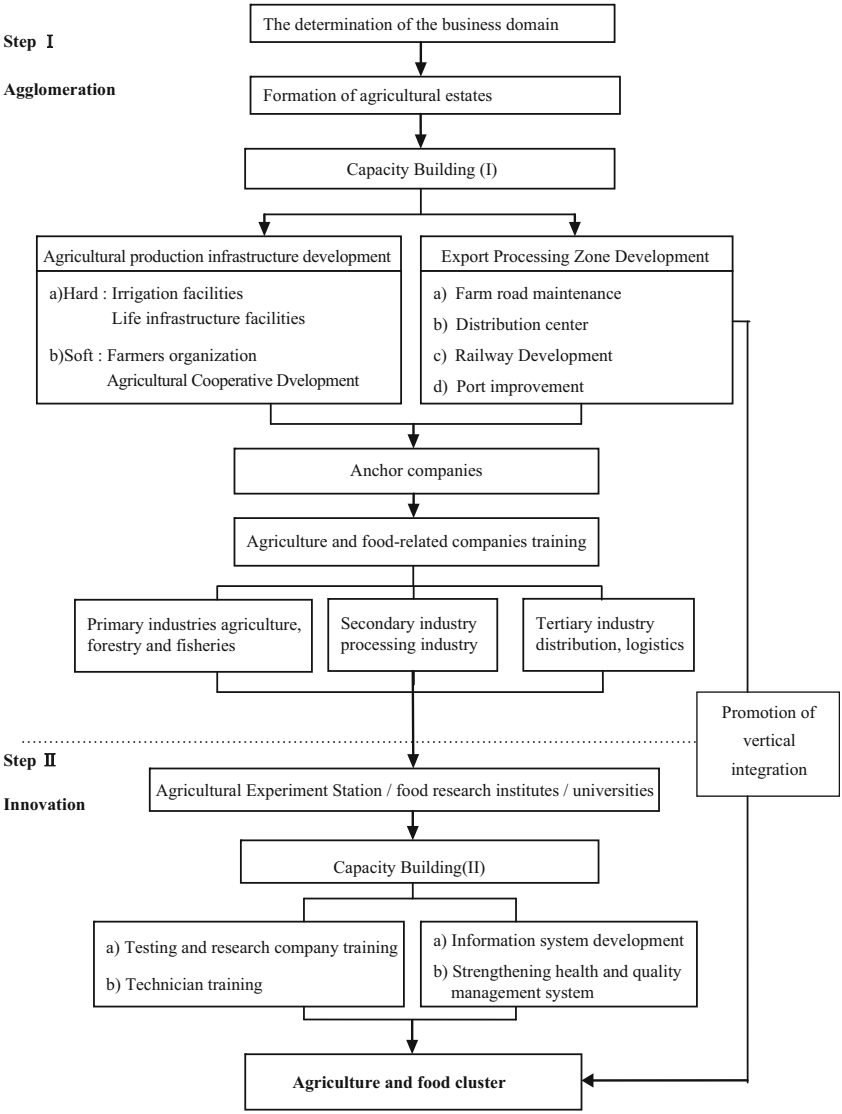

Fig. 11.2 The flowchart approach to agricultural and food cluster policy (*Source*: T. Mizobe)

11.5 A Case Study of an Agro-Food-Processing Industry Cluster in Africa

This section provides a case study of an agro-food-processing industry cluster in Africa based on the flowchart approach. The example studied here is the Nacala Corridor Region located in northern Mozambique, which has one of lowest income levels in the world.

In general, Africa has a number of agricultural advantages in that large areas of land there are suited to labor-intensive agriculture. The demand for agricultural products in African countries is also small so the products can be exported. Consequently, capacity building in the food industry cluster policy should focus on strengthening export competitiveness.

Capacity building, or segment formation, in the food industry cluster is shown in Fig. 11.2. The segments associated with the physical infrastructure include irrigation facilities, agricultural roads, railways, ports, storage and so on to strengthen export competitiveness. The other segments are human resources and institutional capacity. In terms of human resource development, the priority is given to core farmers, labor skilled in the field of agricultural processing, and professionals involved in the inspection of animals, plants and food. In terms of institutional strengthening, the priority is given to a system for financing farmers.

Cluster capacity building results in greater competitiveness in the food industry so that the products obtained from small farmers in developing countries can provide a stable supply to the food industry. It is expected that competitiveness in the agriculture sector is strengthened and that secondary industries such as the machine industry and the equipment industry, which are related to agriculture and the food industry, are developed as a result of the larger market.

The long-term development of "take-off" in Thailand led to it being termed a "newly agro-industrializing country". It takes five to ten years for the agriculture industry to contribute successfully to enhancing the per capita income to a middle-income level, as observed in the case of Thailand. Next, industrial cluster policy moves on to Step II of capacity building to activate innovation and strengthen the competitiveness of the secondary industry to generate the higher added value. The flowchart

approach to the agro-food-processing industry cluster policy consists of Step I (agglomeration) and Step II (innovation), as seen in the manufacturing industry cluster shown in Fig. 11.1.

11.5.1 Increasing Population and High Poverty Line

The Nacala Corridor Region, which runs from east to west, starts in Nacala Port at the Indian Ocean and stretches to Niasa State via the capital of Nampula in Nampula State. It is 600 km long and it crosses the borders of Malawi and Zambia. The region is one of eight belts constituting the well-known Southern African Growth Belt.

Nampula State is at the center of the Nacala Corridor Region. Its population 4 million, and the average population growth rate for the ten years starting from 2011 is estimated at 2.5 %, with the total population in 2020 estimated to be 5.2 million according to the Governo da Provincia de Nampula (2007). The proportion of young people under 15 years is 45 %. The per capita GDP per year is USD202 according to INE (2007), which is lower than the national average. The unemployment ratio is 20 % according to INE (2007). There is a good deal of concern that the number of poor will increase as a result of the increase in unemployment unless additional job opportunities are generated. According to the Direccao Provincial (2009), strengthening agriculture is a priority issue because agricultural laborers represent 90 % of the total labor force in the state.

11.5.2 Small-scale Farmers

Most of the region is classified as a "torrid savanna zone." The rainy season is from October to April and the dry season is from May to September. The area of the state is 81,000 sq. km, its agricultural area is 4.59 million ha and the cultivated area is 1.45 million ha, corresponding to 17 % of the total agricultural area according to INE (2007). There are 720,000 agricultural households located in the state, which represents 24 % of the total agricultural households in Mozambique. As shown in Table 11.3, the number of agricultural households is the highest in the

Table 11.3 Number of farm households by land area

Category (ha)	Number of farm households	(%)	Average land area (ha)
0.1–0.4	172,408	24	0.2
0.0–0.9	265,088	37	0.7
1.0–1.9	216,284	30	1.4
2.0–2.9	41,658	6	2.4
3.0–3.9	11,612	2	3.4
4.0–9.9	6575	1	5.4
10.0–49.9	285	–	20.0
>50.0	11	–	904.0
Total	720,485	100	1.0

Source: Author elaborated by INE (2002)

country. However, the average land holding per household is 1.2 ha, which is lower than the national average of 1.3 ha.

Small-scale farmers (i.e. those with less than 2 ha) comprise 91 % of farmers in the state, as shown in Table 11.3.

Table 11.4 shows the farming situation for small-scale farmers with holdings of less than 1.5 ha. The agricultural income per year is estimated to be MZN6200, or USD295, which is higher than the state average but lower than the national average according to INE (2007).

11.5.3 The Possibility of Developing a Value Chain in the Nacala Corridor Region

The number of effective consumers in Nampula State is about 250,000, located mainly around Nampula City (INE 2007). The ratio of farmers to consumers is roughly 3:1, and an excess supply of agricultural products tends to occur. The region produces the cash crops of cotton, tobacco, cashew nuts and others for processing by exporting firms. Recently, the actual production of soybeans has been increasing as a result of support by non-governmental organizations. For land-intensive agricultural development, the introduction of biofuel crops such as jatropha and sugarcane is an effective strategy.

On the one hand, agricultural products produced by small-scale farmers generate a lot of added value in their marketing and sales as final products, as shown in Table 11.5. On the other hand, sesame is

Table 11.4 Farming system and agricultural income of small-scale farmers

Land ownership scale	1.5 ha				
Labor force	Family labor force: 5–7 people; 3 employed at harvest time (minimum wages MZN45/person/day)				
Cultivation tools	Farm tools (hoe, plow, shovel), pesticide sprayer (for cotton)				
Main crops	Maize	Cassava	Cotton	Cashew nuts	Livestock
Cultivated area (ha)	0.4	0.3	0.7	40 trees	10 chickens,
Yield (ton/ha)	0.5–0.8	4.0–5.0	0.6–0.8	3–4 kg/tree	10 goats
Cropping pattern	Rotation: maize – cassava – cowpea – groundnuts			Year round	Breeding in the backyard
	Seeding: Oct–Dec		Seeding: Nov–Dec		
	Harvest: Apr–Jun		Harvest: Apr–May		
Unit price (MZN)	3.5/kg	Self-sufficiency	8–9/kg	9–14/kg	Chicken 800–1000
Gross income (MZN)	500	–	4500	1700	–
Production cost (MZN)	–	–	500	–	–
Estimated income (MZN)	6200/year (USD295)				

Source: Author, based on field survey 2010
Note: USD1 = MZN0.048 (2010)

Table 11.5 Value-added formation according to the crops unit: USD/kg

	Cotton	Cashew nut	Sesame	Tobacco	Soybeans
Farm gate price	0.40	0.50	1.02	1.20	0.50
Wholesaler price	ND	ND	ND	ND	ND
	ND	0.60	ND	ND	ND
Industry	1.20 (lint)	4.50	1.07	3.15	ND
FOB	0.70 (oil)	ND	ND	ND	ND
Final destination	Export	Export	Export	Export	Domestic

Unit: USD/kg means US dollars per kg
ND means No Data; *FOB* means Free on Board
Source: Author, based on field survey, 2010

exported unprocessed owing to a lack of infrastructure for its processing, even though value is added when it is converted to edible oil.

11.5.4 Potential for the Generation of Employment Opportunities by Food-processing Firms

Mega project firms with direct foreign investment in Mozambique develop mineral resources. Table 11.6 compares the mega project firms with the food-processing firms in the Nacala Corridor Region in terms of investment value and employment opportunities generated. On the one hand, the investment of the mega project firms is large at USD1 billion to USD2.5 billion, and the firms implement capital intensive projects in and around metropolitan Maputo. On the other hand, more than 20 small-scale agricultural processing firms in the Nacala Corridor Region produce cashew nuts, cotton, tobacco, sesame, bananas, soybeans, poultry and so on.

Although the investment of these firms in the Nacala Corridor Region is small, ranging from USD50,000 to USD80 million, the investment is labor intensive in type. A poultry firm in the Nacala Corridor Region invested USD1.3 million, and it employs 1070 workers and contracted farmers, while the Mozal aluminum refinery, the largest of the mega project firms, employs a workforce of only 1000. Moza Banana started operation to produce bananas in 2009 and it employs 18,000 people. Thus Moza's potential for generating employment opportunities is greater than that of the mega project firms.

Table 11.6 Employment potential of food-processing companies in the Nacala Corridor Region

	Mega industry company			Food-processing firm			
	Mozal	Sasol	Moma	New Horizontal	Sonil Fabrica	Condor Nuts	Moza Banana
Industry type	Aluminum	Natural gas	Metal	Poultry farming	Cigarettes	Cashew nuts	Bnanas
Investment (USD million)	2400	1200	500	1.3	–	–	80
No. of employees	1000	–	425	Factory 186 Farm 890	Factory 100 Farm 2500	Factory 750 Farm ND	Farm 18,000
Final market	Export	Export	Export	Domestic	Export	Export	Export

Source: Author, based on field survey

11.5.5 Proposed Model of the Agro-Food-Processing Industry Cluster for the Nacala Corridor Region

In Sect. 11.2 we concluded that the value of the summation of backward linkage and forward linkage effects for the machinery industry is almost the same as that for the food industry. Table 11.6 supports the fact that the food industry can generate more employment opportunities than can the mineral mining industry.

Consequently, we proposed a model of the agro-food-processing industry cluster for the Nacala Corridor Region, as shown in Table 11.7. This would be practical and easy to introduce. The agro-food-processing industry covers a range of industries which generate high value for the forward and backward linkages effects of the industries. The cluster proposed here consists of industries associated with compound feed, vegetables, fruit, wood, cotton and biofuel.

Industrial linkages can be explained as follows. The compound feed industry cluster starts with small farmers producing soybeans as a primary industry. The soybeans are then processed to give soybean oil and compound feed as a byproduct as secondary industries. The related industries, such as fertilizers, pesticides, logistics and marketing, are engaged in the exchange of compound feed. The logistics and marketing industries are tertiary industries, so that it is hoped that sextiary industry, or primary-secondary-tertiary industry, can be established in the Nacala Corridor Region.

As shown in Table 11.7, the processes promote the development of industries supporting the related industries, resulting in the emergence of a huge agriculture industry. The first row shows both the industries related to the primary industry, secondary industry and tertiary industry, as well as examples of the agricultural products, intermediate products and final products. It appears to be practical as a development strategy by which African countries can strengthen the competitiveness of their agro-food-processing industry.

11.6 Concluding Remarks

This chapter has established an agro-food-processing industry cluster policy for Africa by applying a prototype model of the flowchart approach to industry cluster policy. In particular, the cluster was modeled using our

Table 11.7 Proposed agro-food-processing cluster model in the Nacala Corridor Region

Cluster	Industry			Crops	Processing products	Final products
	Primary	Secondary	Tertiary			
Compound animal feed	Cereals, livestock products	Compound feed, Dairy products, Meat	Fertilizer, Chemicals, Storage, Marketing, Logistics	Maize, Cassava, Soybeans	Compound animal feed	Poultry, Beef, Milk
Vegetables	Vegetables	Frozen vegetables, Canned Vegetables	Fertilizer, Chemicals, Storage, Marketing, Logistics	Tomato	–	Tomato puree, fresh tomatoes
Fruit	Perennial fruits	–	Storage, Marketing, Logistics	Cashew nuts, Bananas, Oranges	–	Fruit juice, nuts, table bananas
Wood	Forestry, Kenaf production	Lumber, Plywood, Manufacturing, Paper	Storage Marketing, Logistics	Forest resources, Kenaf, Bagasse	–	Furniture, Plywood, corrugated cardboard
Cotton	Cotton products	Spinning, Textiles	Storage, Marketing, Logistics	Cotton	Yarn, Cloth	Yarn, Cloth, Clothes
Biofuel	Sugarcane, Jatropha	Refined sugar, Biofuel	Storage, Marketing, Logistics	Sugarcane, Jatropha		Biofuel products

Source: Author, based on field survey

research data on the Nacala Corridor Region in the north of Mozambique, one of the poorest countries in Africa. Based on the above, the following four conclusions were drawn.

First, the value of the forward and backward linkage effects of the machinery industry is almost the same as that of the food industry, as shown in Table 11.2. Second, a model of the flowchart approach to an agro-food-processing industry cluster was formulated and is anticipated to strengthen the input–output linkage and generate employment opportunities, as shown in Fig. 11.2. Third, it was found that, in the Nacala Corridor Region in Mozambique, the food industry can generate more employment opportunities than can the mineral mining industry, as shown in Table 11.6. That is, the research data show that small investments by food-processing businesses in the study region generated more employment opportunities than did the mega mineral mining firms in Mozambique. Fourth, the summing of the three conclusions above allowed a cluster policy proposal for the development of African regions to be constructed for improving the low agricultural incomes mainly resulting from the large number of small-scale farmers and their limited markets, as shown in Table 11.7.

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