Agricultural Change and Unstable Production over a 20-year Period in a Central Zambian Village

— Under the Penetration of a Market Economy and the Farmers’ Response —

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Abstract In Zambia, the development of the market economy and free trade has affected agricultural production and the rural economy since 2000s. This paper focuses on the change in the farming from both technological and economic viewpoints. The focus is on maize production and small-scale irrigation farming using small engine pumps in the wetlands in addition to modern inputs such as fertilizer, seeds and chemicals. They have attained crop diversification, two crops a year of maize and high rates of farm production. However, high-cost agricultural production may increase vulnerability of some farmers who can’t afford to pay for the cost.

Key words irrigation farming, small engine pump, vegetable production, crop diversification, two crops a year of maize, modern agricultural inputs

1. Introduction

In 1991, Zambia became a multiparty democracy, representing a shift in the political and economic milieu from a socialist, government-led economy to the liberalizing of the market economy. Unfortunately for Zambia, its economy has declined dramatically in the 1990s. However, since 2001 under the “New Deal Policy” of the previous president, President Mwanawasa (2001-8), greater emphasis has been placed on the agricultural and rural sectors. Thus, the development of the market economy and free trade is significantly affecting agricultural production and the rural economy, particularly since the 2000s. The Banda government, which has been in power since 2008, is also focusing on the agricultural and rural sectors.

How are the agricultural and rural sectors, particularly the small-scale farming sector, affected by the development of the market economy? It is difficult to differentiate the effects of the market economy development from those of the changes in the agricultural policy. According to the World Bank, Zambia has produced a strong macro-economic performance, coupled with fast-paced growth in mining, construction, telecommunications, and tourism, which has resulted in an average 5.6% growth in GDP for 2001-2010 (with a peak of 7.6% in 2010). Surging copper prices, from 2004 to the present day, have rekindled international interest in Zambia’s copper sector.

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Such a high rate of economic growth has resulted in a growing demand for food.

This paper explores the changes in agricultural production from both technological and economic viewpoints. The focus is on maize production (with maize as both a staple food crop and a cash crop) and small-scale irrigation farming using small engine pumps in the wetlands (dambo). The data used come from a village where field surveys have been conducted for almost 20 years (1992-2010). In the mid-2000s, farmers from this village began to use small engine pumps (hereafter, engine pumps). The engine pump, as an agricultural investment, is one of the most expensive assets for the small-scale farmer. As will be discussed in greater detail further in the paper, these farmers have responded positively to the economic incentives purchased by way of the greater opportunities that have arisen from the development of the market economy.

The entrance of the village (a small town is positioned there) is located about 90 km north of Lusaka. The land area of the village covers approximately 5-6 km² and it is positioned approximately 3 km southeast, at its closest point, from the entrance and 8 km from the innermost point in a straight line. The small town, which is expanding, has many stalls selling a variety of crops, including tomatoes and watermelons. Prior to the early 2000s, there were no shops in the village but now there are shops selling a range of goods including seeds, chemical fertilizers, and agro-chemicals. Before we analyze the small-scale irrigation farming practices of the village, we should discuss large-scale irrigation farming, particularly the center pivot method.

2. Irrigation Farming Methods of Large-scale Farms

Under the National Irrigation Plan (NIP), as part of the National Development Plan (NDP) for 2006-2011, the Ministry of Agriculture and Cooperatives has designed a National Irrigation Strategy that will provide guidance to all levels and types of investments in irrigated agriculture. Zambia has over 1,740,380 million m³ of underground water resources and possesses over 423,000 ha of irrigable land, of which approximately 100,000 ha is irrigated by large-scale, emergent, and smallholder farmers. It was recommended that during the first 2-3 years of the NIP/NDP, duties and VAT on basic irrigation equipment be reduced to a manageable level. It is also important that customs and excise duties, as well as the base-lending rate for irrigation equipment loans, be reduced. The total direct resource commitment is estimated at US$150 million for the five-year period. The International Development Fund (IDF) is a source of capital for farmers and industry operators to invest in irrigation-related projects and technology acquisitions if they meet the following criteria: 1) Reduction in the cost of irrigation equipment. Most equipment required for irrigation is imported and therefore subject to duties and VAT charges. 2) Peri-urban and out-grower farmers can access the IDF through their out-grower promoting companies for their basic package of irrigation tools and equipment. 3) Smallholder farmers using dambo and other water sources can access their basic irrigation package through contracted micro finance institutions with a 50% subsidy. 4)
Large-scale commercial, private, and some emerging farmers may approach the IDA directly for their concessional loans to purchase costly basic irrigation packages. 5) Manufacturers of irrigation equipment and tools wishing to expand or test new irrigation technology for import substitution and cost saving, but who lack working capital, can also approach IDA directly to access the IDF².

Since the beginning of the 2000s, the number of center pivot irrigated circle form plots has increased in the large-scale farming sector, with more than 220 circle form plots identified on a Google Earth map in September 2008. Surveys in 2009 and 2010 confirmed that the main growing crops for the Lusaka area are wheat, coffee, maize for seeds during the dry season, and soybeans, maize, and other vegetables during the rainy season. Thus, there is no strong competition between the large-scale farming and small-scale farming sectors in terms of growing crops because most small-scale farmers do not grow these crops at all, and those that do, do so at a much smaller scale except maize and vegetables. Most of the large farms irrigate with dammed surface water, not underground water, which removes the problem of having to pump massive quantities of water. However, no matter what method used, there are no basic data regarding irrigation farming, and as such, relevant statistics should be collected.

3. Expanding of Agricultural Markets

3-1 Farm Inputs

As already mentioned, the small town near the entrance of the village has experienced recent expansion. The Google Earth satellite photos in Figs. 1 and 2 show this expansion.

As of August 2010, there were three shops selling farm inputs such as crop seed, chemical fertilizer, and chemicals. Prior to the late 1990s, farmers had to visit Kabwe, a provincial city nearby the village, or Lusaka to purchase agricultural inputs. Even now, some farmers visit to these cities to purchase agricultural inputs because of cheap prices and better quality goods. The use of mobile phones has also increased the opportunities for economic transactions, as it is now very easy to obtain price information. For example, a farmer bought 62 bags of top dressing fertilizer at Dodoma, Tanzania, on August 15, 2009, at a price of ZK (Zambian kwacha) 120,000 per bag, after receiving pricing details from a friend via his mobile phone. Then he arranged transportation to bring them into his village, with
a transportation cost per bag of ZK18,000. The total cost including transportation costs was cheaper than the fertilizer in Zambia.

In July 2010, a farmer opened a shop on the village tarmac road selling farm inputs. The rent is ZK150,000 per month (approximately US$30). This shop made an agency contract with Pioneer, a company that sells seeds for a variety of crops. The owner of the shop received training from Pioneer regarding how to advise farmers on the use of weed killer as well as selling seeds.

3-2 Agricultural Products

Recent observations have shown that there is now a greater range of agricultural products in the markets alongside the tarmac road and even in the village farms. At the end of the 1990s, the main crops for sale in the village were maize, tomatoes, watermelon, Chinese rape, and a small number of other crops. In addition to these traditional crops, others are now being grown including maize in the dry season, popcorn, sweet potatoes, cowpeas, beans, impua, eggplant, okra, leek, onion, green pepper, cabbage, Chinese cabbage, squash, and butternuts. Since the mid-2000s, the demand for food has grown, particularly from mine workers.

4. Introduction of the Small Engine Pump

Since the mid-2000s, the number of farmers who are using small engine pumps has increased (Table 1). By the end of August 2009, 13 farmers had purchased such pumps (See photo 2 in p. 237).

A further five farmers purchased pumps by the end of 2010, bringing the true total to 18 farmers, of which three were females (one farmer left the village in 2010). The farmers with small engine pumps accounted for approximately 10% of the total number of households in the village and their average age was 40.8 years old. All of the farmers purchased the pump using their own funds (See photo 3 in p. 237). The price of a pump attached to a small 5.5 horsepower engine was approximately US$400-500, excluding the cost of the inlet and outlet pipes. Those farmers that have no pipes for irrigation water (these are very few in number) borrow them from their friends, neighbors, and relatives.

In 2001, an NGO began various activities promoting irrigation farming in the village. Those farmers who became involved in those activities received treadle pumps via a loan offered by the NGO (See photo 4 in p. 237). Forty percent of farmers with an engine pump had previously used a treadle pump to irrigate their farms. Before the introduction of the treadle pump, many farmers grew crops such as tomatoes, watermelons, and Chinese rape in dambo gardens during the dry season and watered them using buckets. The number of fields growing maize (green maize or winter maize) during the dry season (some farmers are now planting maize prior to the rainy season) is increasing in the village, particularly among the farmers using engine pumps. This will be discussed in greater detail later in the paper.

Most of the farmers who use engine pumps live in the eastern part of the village near the forest reserve. The reason for this is that their houses and farming lands are nearer to areas where surface water is available year round, even during the dry season between April and September (close to 6 months of the year). In terms of water avail-
ability during the dry season, three water sources exist for the farmers: a) surface water, b) water from wells, or c) both surface and well water. Most of the engine pump owners use surface water for irrigation, and a small number (four to five farmers) use only well water (See photo 5 in p. 237). There is some concern that the lowering of the water table by pumping excessive water will damage dambo cultivation in the areas that depend on wells.

Although village land is under the Lenje chieftaincy, many ethnic groups have lived together since the village was established in the late 1960s. The ethnic composition of engine pump owners is as follows: Lenje (3), Tonga (3), Ngoni (1), Nyanja (1), and Zimbabwean descents (10). In short, non-Lenje people make up over 80% of the pump owner group and are mostly blood or marriage relations. Several generations ago, the ancestors of the Zimbabwean members lived in the forest reserve. They are conscious of the notion of “our own land” because an influential statesman (in response to a family member) lobbied the government to move the boundary and obtained permission to live there.

### Table 1 Description of Engine Pump Owners

| No | Sex | Age in 2010 | Ethnic Group | Acquisition Month/Year | Acquisition ZK | New/Old | Treadle Pump | Remarks |
|----|-----|------------|--------------|------------------------|----------------|--------|--------------|---------|
| 1  | F   | 37         | Zimbabwe     | 2004/9                 | 3,000,000      | New    | –            | engine trouble in Oct. 2010 |
| 2  | M   | 37         | Tonga        | 2005/6                 | 800,000        | Old    | 2004         |
| 3  | M   | 36         | Tonga        | 2006/8                 | 700,000        | Old    | No           |
| 4  | M   | 47         | Lenje        | 2007/6                 | 1,200,000      | New    | 2002         |
| 5  | M   | 50         | Zimbabwe     | 2007/8                 | 1,300,000      | New    | 2001         |
| 6  | M   | 47         | Lenje        | 2007/8                 | 1,250,000      | New    | 2001         | she left the village in 2010 |
| 7  | F   | 29         | Zimbabwe     | 2008/6                 | 1,250,000      | New    | –            | mother’s |
| 8  | M   | 28         | Zimbabwe     | 2008/7                 | 1,900,000      | New    | 2004         | he sold old engine in Oct. 2010 |
| 9  | M   | 37         | Zimbabwe     | 2008/7                 | 1,800,000      | New    | 2003         |
| 10 | F   | 47         | Zimbabwe     | 2008                   | 1,200,000      | New    | 2001         |
| 11 | M   | 53         | Zimbabwe     | 2009/3                 | 1,700,000      | New    | No           |
| 12 | M   | 37         | Tonga        | 2009/5                 | 2,000,000      | New    | 2002         |
| 13 | M   | 36         | Tonga        | 2009/7                 | 1,200,000      | New    | No           |
| 14 | M   | 46         | Ngoni        | 2009/11                | 1,775,000      | New    | No           | farther born in Zimbabwe |
| 15 | M   | 55         | Zimbabwe     | 2010/5                 | Exchange       | Old    | No           |
| 16 | M   | 28         | Zimbabwe     | 2010/6                 | 2,600,000      | New    | 2004         | mother’s |
| 17 | M   | 39         | Zimbabwe     | 2010/6                 | 1,300,000      | New    | No           | same person with no 8, bought second pump |
| 18 | M   | 41         | Zimbabwe     | 2010/6                 | 970,000        | Old    | No           | bought from MS of a neighbor |
| 19 | M   | 52         | Lenje        | 2010/6                 | 1,700,000      | New    | No           |
| 20 | M   | 34         | Nyanja       | 2010/7                 | 1,450,000      | New    | No           | his elder sister is a wife of Zimbabwean farmer |

Source: survey by author
5. Agricultural Production of Farmers with Engine Pumps

5-1 Maize Production during Rainy Season

Table 2 shows the situation regarding the farm holdings of farmers with engine pumps. Their average total land is approximately 12 ha, a relatively large land holding. The average area of maize-cropped land in 2010/11 increased by 0.8 ha over that from the previous crop year. It is believed that the government maize production policy the “New Deal Policy”, which includes the “Farmers Input Support Program” (FISP) and purchasing maize through the Food Reserve Agency, has stimulated production. However, some farmers planted alternative crops like popcorn, expecting a higher price.

There are now many more varieties of maize seed available. Most farmers renew their maize seed every season and it is easy to grow high-yielding maize varieties, including hybrids, near the village, while the number of local varieties is decreasing. Table 3 shows the application of chemical fertilizers (total of all basal and top dressing fertilizers, 251 kg) and the maize yield (2.6 ton per ha) for the 2009/10 crop season. The table shows that farmers applied 63% of the recommended fertilizer measure of 400 kg/ha for that season. The method of fertilizer application has

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### Table 2  Farmland Holdings of Farmers Using Engine Pumps

|     | upland (ha) | dambo (ha) | total (ha) | maize area (ha) |
|-----|-------------|------------|------------|----------------|
|     |             |            |     08/09  |     09/10  |     10/11  |
| 1   | 1.5         | 1.0        | 2.5       |   -        |   0.5    |   0.7    |
| 2   | 2.0         | 1.0        | 3.0       | 0.5        | 0.8      | 2.2      |
| 3   | 5.0         | 1.5        | 6.5       |   -        | 1.3      |   -      |
| 4   | 5.0         | 1.9        | 6.9       | 3.0        | 1.8      | 4.0      |
| 5   | 5.0         | 2.0        | 7.0       |   1.0      |   -      |   -      |
| 6   | 6.2         | 0.8        | 7.0       |   -        | 2.0      | 4.0      |
| 7   | 6.8         | 0.9        | 7.7       |   -        | 1.8      | 1.5      |
| 8   | 7.0         | 2.0        | 9.0       | 2.5        | 2.0      | 3.0      |
| 9   | 8.0         | 3.0        | 11.0      | 0.8        | 2.0      | 3.3      |
| 10  | 4.5         | 7.4        | 11.9      |   -        | 1.2      | 1.4      |
| 11  | 12.0        | 0.8        | 12.8      | 1.5        | 1.0      |   -      |
| 12  | 8.0         | 5.0        | 13.0      | 2.0        | 1.0      | 3.5      |
| 13  | 16.0        | 2.0        | 18.0      | 1.5        | 0.5      | 2.3      |
| 14  | 5.0         | 14.0       | 19.0      |   -        | 0.8      | 0.5      |
| 15  | 7.4         | 12.0       | 19.4      |   -        | 1.5      | 2.4      |
| 16  | 19.0        | 2.5        | 21.5      |   -        | 1.0      | 1.3      |
| 17  | 20.0        | 3.0        | 23.0      |   -        | 6.3      | 1.8      |
| 18  | 17.0        | 7.0        | 24.0      |   -        | 1.0      | not yet  |
| avg | 8.6         | 3.8        | 12.4      | 1.6        | 1.5      | 2.3      |

source : survey by author

### Table 3  Fertilizer Use for Maize

| fertilizer kg/ha | yield kg/ha | remarks |
|------------------|-------------|---------|
| 1                | 100         | 850     |
| 2                | 100         | 1,500   |
| 3                | 128         | 1,200   |
| 4                | 133         | 547     |
| 5                | 167         | 1,650   |
| 6                | 185         | 3,330   |
| 7                | 200         | 2,160   |
| 8                | 200         | 6,300   |
| 9                | 240         | 1,800   |
| 10               | 250         | 1,313   |
| 11               | 250         | 1,440   |
| 12               | 300         | 2,500   |
| 13               | 325         | 7,000   |
| 14               | 343         | 3,314   |
| 15               | 400         | 3,150   |
| 16               | 400         | 2,250   |
| 17               | 550         | 3,850   |
| avg              | 251         | 2,597   |

source : survey by author  
FISP : Farmer Input Support Program
also improved. Previously, the majority of farmers applied both basal and top dressing fertilizers at the same time to maize plants once they grew to knee-height, approximately 30 cm.

Many farmers now recognize the benefits of applying the fertilizer types separately, presumably according to the manufacturers’ recommendations. Such technological improvements in terms of fertilizing can be attributed to the intensification of maize production (Fig. 3). Of the 17 engine pump users, only four were using FISP.

5-2 Growing Green Maize during the Dry Season

As already mentioned, it is easy for those farmers with engine pumps to grow maize (green maize) during the dry season, so easy that they can grow two crops a year. While this is a revolutionary farming practice in Zambia from the viewpoint of food security in villages, it is not used on large-scale farms. Some farmers have planted green maize using treadle pumps, but did so on very small fields. Even in areas with abundant water resources, it is not easy to irrigate maize fields using a treadle pump because it is a very labor-intensive practice. Approximately half (53%) of all engine pump users planted maize during the 2010 dry season, with an average field size of 0.31 ha (Table 4).

However, both the number of farmers and field size has decreased compared with 2009. The main reason was the bumper harvest of rainy season maize in the 2009/10 crop year, which resulted in low prices for maize. The preceding maize harvest (either a rich harvest or a poor harvest in the rainy season) affects the planting of maize in the coming dry season.

Fig. 4～6 shows the green maize growing seasons for the last 3 years, with a very long May to March period of almost 1 year. However, the beginning of the planting period is likely to start later. In addition, farmers are working on a trial-and-error basis regarding green maize production because it is a relatively new practice with many considerations (e.g., weather conditions, water resource availability, and petrol prices). There are also further risks including attacks on fields and grazing animals eating the maize.

5-3 Sale of Crops

According to annual crop sales for engine pump farmers in 2010 (Table 5, 6), their sales were comprised of 60% dambo products and 40% upland-farmed products. As the definitions for dambo
and upland are somewhat ambiguous regarding the nature of the soil, it is likely that the difference lies in the cropping season. In particular, the crop mix of *dambo* (dry season) and upland crops (rainy season) is very important to the farm economy. The cash income received from selling *dambo* crops purchases farming inputs like seeds, fertilizer, and chemicals. Maize (65.7%), watermelons (12.1%), popcorn (7.9%), and tomatoes (7.4%) from upland farming, and *dambo* tomatoes (47%) and watermelon (12.9%) represent a significant percentage of total sales (See photo 6 in p. 237). Three crops, tomato (49.7%), maize (26.8%), and watermelons (12.9%), are the major income sources, representing 89.4% of total crop sales. In 2010, farmers earned a total average crop sale of ZK14.3 million (approximately US$3,000 : US$1 = ZK4,700).

Only five farmers sold green maize, and some farmers lost their entire watermelon harvest to an unnamed disease. Although the total average annual crop sale per farmer was approximately
Fig. 6  Green Maize Production Using Engine Pumps in 2010

Table 5  Annual Crop Sales for Pump Engine Users in 2010 (Upland)  unit : ZK

| upland | maize | g. nuts | w. melon | tomato | c. rape | g. pepper | p. corn | sub-total |
|--------|-------|---------|----------|--------|---------|-----------|--------|----------|
| 1      | 240,000 |         | 105,000  |        |         |           |        | 345,000  |
| 2      | 637,500 |         | 1,400,000|        |         |           |        | 2,037,500|
| 3      | 360,000 |         | 2,800,000|        |         |           |        | 3,160,000|
| 4      | 288,000 |         | 375,000  | 4,785,000|        |           |        | 6,225,000|
| 5      | 2,860,000| 120,000 |         |        |         |           |        | 7,645,000|
| 6      | 7,200,000| 250,000 |         | 1,450,000|        |           |        | 2,420,000|
| 7      | 3,200,000|         |         | 3,200,000|        |           |        | 3,104,000|
| 8      | 8,744,000|         |         |         |         |           |        | 8,744,000|
| total  | 51,629,500| 120,000 | 9,530,000| 5,850,000| 4,785,000| 500,000  |        | 78,604,500|
| %      | 24.0   | 0.1     | 4.4      | 2.7    | 2.2     | 0.2      | 2.9    | 36.5     |
| avg    |        |         |          |        |         |          |        | 5,240,300|

source : survey by author
US$3,000, there is a considerable difference between the farmers.

According to the World Bank, per capita GDP of Zambia in 2010 was US$1,225. The total average annual crop sale US$3,000 of the farmers on Fig. 9 includes all of the production cost. Even if the total cost excluding family labor cost was 70% of crop sale, the gross income per family was comparable to the per capita GDP of Zambia. Also according to the World Bank, poverty headcount ratio at national poverty line and Gini index were 60.5 and 57.5, respectively in 2010. This means that income differentiation is very high.

Before discussing on production costs in the following section, I have to note about the farm income differentiation. The size of income is not necessarily correlated with the size of farm land, both upland and dambo. Rather, it would be the size of family labor, particularly in peak season on farming. The cost of chemical fertilizer and other chemicals like pesticide and fungicide accounts for high percentage of the total cash cost. Due to unreliable rainfall, particularly in the beginning of rainy season, farmers sometimes lost return from costly and valuable investment. The timing of planting of crops, weeding and fertilizing is very important to get good harvest. Harvesting time of vegetables, particularly tomato is also very important because of the price fluctuation. There are two peaks of high price of tomato in a year, June and December. Both of these months are off season for tomato; pre-harvest month for dambo farming in June and for rain season farming in December. Thus unforeseeable change of weather and difficult standardization of farming technology has contributed to the irregularity of

| eggplant | g. maize | w. melon | tomato | onion | b. nuts | impua | c. rape | sub-total | total | ZK (=US$) |
|----------|----------|----------|--------|-------|---------|-------|---------|-----------|-------|-----------|
| 1        | 600,000  | 850,000  | 1,560,000 |       |         | 1,560,000 | 0 | 1,905,000 | 405  |
| 2        | 800,000  | 5,400,000 | 5,349,000 | 5,349,000 | 840,000 | 6,989,000 | 6,989,000 | 1,487 |
| 3        | 1,522,000 | 1,400,000 | 840,000  | 1,400,000 | 840,000 | 6,989,000 | 7,482,000 | 1,592 |
| 4        | 1,850,000 | 7,890,000 | 840,000  | 7,890,000 | 840,000 | 6,989,000 | 8,178,000 | 1,740 |
| 5        | 45,000   | 54,000   | 2,335,000 | 2,335,000 | 840,000 | 2,434,000 | 2,434,000 | 1,842 |
| 6        | 3,000,000 | 3,760,000 | 320,000  | 320,000  | 840,000 | 3,320,000 | 10,965,000 | 2,333 |
| 7        | 4,700,000 | 13,780,000 | 1,950,000 | 1,950,000 | 840,000 | 20,030,000 | 22,450,000 | 4,777 |
| 8        | 13,780,000 | 25,000,000 | 7,805,000 | 25,000,000 | 840,000 | 11,962,000 | 43,007,000 | 9,150 |
| 9        | 18,000,000 | 19,070,000 | 840,000  | 19,070,000 | 840,000 | 24,522,000 | 54,594,000 | 10,977 |
| 10       | 22,000,000 | 38,250,000 | 840,000  | 38,250,000 | 840,000 | 24,522,000 | 54,594,000 | 10,977 |
| total    | 45,000   | 5,976,000 | 101,113,500 | 101,113,500 | 840,000 | 136,529,500 | 215,134,000 | 45,773 |
| % 0.0    | 2.8      | 8.5      | 47.0    | 0.3      | 0.9    | 3.6    | 63.5    | 100.0   |
| avg 9,101,967 | 14,342,267 | 3,052 |
income differentiation.

5-4 Production Costs of Tomatoes

Table 7 shows the production costs for tomatoes for farmer A (No.14 on Table 5,6) on 0.24 ha, between September and December 2010. He has recorded the data using his mobile phone’s memory function. As the harvesting of tomatoes continues into the January of the following year, the final income and expenditure is unknown (See photo 6). Total tomato sales reached ZK1.9 million (US$404) at the end of December 2010, with total costs of ZK3.85 million (US$819). At that time, farmer A had only recovered half of his costs, which include chemical fertilizers (28.9%) and chemicals (29.1%). These costs represent approximately 60% of the total costs. The first rain did not fall until November 1, 2010, and the fuel costs for irrigation using a small engine pump was 14.3%. Labor costs (employed workers) were only 2.8% of the total costs.

This case study shows that farmer A faces significant costs (he has to buy, for example, poles and ropes to make tomato stands) and therefore requires a substantial cash investment to grow tomatoes. Farmer A had to borrow money to purchase his required inputs from a trader and then promised the trader that he would sell him good quality, bigger sized tomatoes on a preferential basis in the coming season.

6. Conclusion

Since the early 2000s, irrigation farming has been on the rise in Zambia. The number of center pivot style irrigation plots is rapidly increasing in the suburbs surrounding Lusaka as well as in other places. Even in small-scale farming areas, for example a village in Central Province, small engine pumps have been introduced and 10% of family farms now use irrigation during the dry season. Most of these families are immigrant inhabitants. They are live in the eastern and southeastern parts of the village and use surface water for irrigation to grow vegetables, maize, and other crops. Only 20% of engine pump users pump water from wells.

Unlike a bucket or treadle pump, irrigation using an engine pump can cause a lowering of the water table because it can pump massive amounts of water at any one time. Prior to the engine pumps arriving in the village, an area close to the dambo was used to grow vegetables during the dry season. Now, however, the area is not used for such purposes. There are four farmers with engine pumps, who now grow crops on a relatively
large-scale close to this area, but at a lower elevation. There is no scientific evidence to support a causal relationship between the pump engines and the gardens that are now in disuse. One of the farmers offered an alternative reason why the area was no longer used as a garden, one that was not linked to the use of pump engines.

After the liberalization and privatization of the Zambian economy, Zambia is enjoying a copper boom. Since the beginning of the 2000s, the price of copper has skyrocketed worldwide and the agricultural market is expanding in response to a greater demand for domestic agricultural products. Furthermore, President Mwanawasa’s “New Deal Policy” remains and still provides more affordable subsidized inputs to farmers. With regard to the agriculture sector, we can confirm high economic growth and the development of the market economy in rural areas, even though these areas are near to the capital Lusaka. The farmers can now easily purchase farming inputs, such as improved and various seeds, chemical fertilizers, and chemicals, at the small but growing town nearby the village. Agricultural diversification in terms of production is also occurring gradually.

In contrast, the increasing use of expensive inputs may bring about high-cost farming and consequently may result in a shortage of funds. There are three ways to prevent such high demands on available funds: 1) increase the use of farm-made inputs like animal dung instead of using of expensive inputs, for instance fertilizers, 2) use institutional credit like government or NGO assisted and subsidized credit programs, and 3) use private moneylenders. It is important to create new systems, like leverage finance, to multiply gains and losses.

Serious problems will ensue if the income differentials between owners and non-owners, seen for example in land (dambo) ownership and physical capital (engine pumps), continue to grow. There are signs in the village of the increasing presence of capitalism. For example, it was noted that two people with salaried incomes began to grow maize on a large rented property in the village. They were not traditional farmers and rented the farmland from the villagers. In addition, they hired tractors to plow the maize fields. Thus, the development of a market economy may produce an unstable rural society.

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Footnotes
1 Kodamaya (2011), 19-39.
2 Online: http://web.worldbank.org/WEBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/ZAMBIAEXTN0, menuPK: 375684~pagePK: 141132~piPK: 141107~theSitePK: 375589,00.html (accessed on May 27, 2011).
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ザンビア中部州—農村における農業の技術変化と不安定な生産

— 市場経済の浸透と農民の反応 —

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要旨 ザンビアでは2000年以降、市場経済の発展と貿易の自由化が農業生産と農村経済に大きな影響を与えている。銅価格の上昇が主因でGDPの年平均成長率は5.6％（2001-2010年）となり、その結果、国内の食料需要は増大してきた。本論文は、これらの変化について—農村を対象に技術的・経済的な観点から考察した。大農部門では大型灌漑設備をもつ農場が増えているが、小農部門でも化学肥料や改良品種などの投入財に加え、小型エンジン・ポンプを利用した灌漑農業が普及し始めた。2010年現在、灌漑用ポンプの普及は村世帯の約1割であるが、灌漑水の大量利用は将来、村の貴重な水資源を圧迫することになると推測される。年1回の雨季と乾季が明瞭に分かれる自然条件下で、天水によるトウモロコシの栽培時期は従来、雨季に限定されていた。村内での地表水や地下水が年中利用できる一部地域では、乾季でも灌漑によるトマトやスイカなどの栽培が盛んであった。小型ポンプの導入はトウモロコシの二期作や野菜栽培など農業生産の多様性を可能にしたが、一方で高費用の農業生産が経済を圧迫し、脆弱性を強めている。小型ポンプによる井戸水灌漑の周辺では、ポンプを所有しない世帯の乾季の栽培面積が縮小している。

キーワード：灌漑農業、小型エンジン・ポンプ、野菜栽培、作物の多様化、トウモロコシの二期作、農業の近代的投入財

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