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THE STRUCTURE OF THE DESERT ECONOMY: RISKS AND STRATEGIES FOR LONG-TERM SUSTAINABLE GROWTH

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THE STRUCTURE OF THE DESERT ECONOMY: RISKS AND STRATEGIES FOR LONG-TERM SUSTAINABLE GROWTH

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The Australian desert economy is a \$90 billion dollar economy. However currently, there is a reliance on a few industry sectors in delivering its output. About 60% of the gross revenue of the desert comes from only three sectors - mining, manufacturing and agriculture. This can pose a risk in light of climate change, increasing interconnectedness of financial markets and the fact that the resources boom is unlikely to be an on-going phenomenon. How can desert economies mitigate risks associated with over-reliance on a few select sectors and ensure continued growth in the long run? This paper discusses the structure of the desert economy and strategies to mitigate the risks of overdependence on a few industries. Using a regional input-output model, the study shows which industry sectors are likely to provide the highest multiplier impacts on the economy with implications on strategic investments for sustained growth and development of desert regions in Australia.

1. Introduction

The desert region of Australia covers about 69 per cent of the Australian landmass². It is home to over half a million people. On average, the desert generates a per capita gross regional product (GRP) of about \$80k, about one-and-a-half times higher than the national average. The region is rich in natural resources. It is home to some of the world's largest mining operations in iron ore, gold, nickel and other mineral resources.

Despite the massive wealth generated in the desert, the desert is also a fragile environment, fraught with risk, which means that it could easily be affected by global challenges such as climate change and external changes including economic cycles, thus, putting its residents and those relying on the desert for their livelihood, at risk. A key concern therefore of desert stakeholders, including local and state governments, is how to ensure that these risks are mitigated or economic development strategies put in place to mitigate the risks and enable resilience of the desert economy.

Economic resilience is the ability of a community or region to be able to absorb economic shocks and quickly begin a rebound and reach an equilibrium that although, may be different from the pre-shock condition, is able to provide similar employment levels and preserve the community's population (Sorte and Campbell 2004). To be able to develop appropriate economic strategies, understanding the structure of the economy is important.

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² Deserts are defined as arid and semi-arid regions (see www.desertknowledgecrc.com.au).

Input-output analysis offers one way of analysing the structure of an economy. Input-output analysis is a method of systematically quantifying the mutual interrelationships among the various sectors of a complex economic system (Leontief, 1936). The economic system referred may vary from a single firm or enterprise to a small regional economy, and even to a whole nation or the entire world. Input-output analysis is attractive because of its flexibility, simplicity, and its wide range of uses for development planning. It can be used to provide an overview of the system of accounts of the economy and show the structure of the economy, indicating the nature of the economy in terms of significant and insignificant categories of transactions and the economy's structural characteristics. Input-output analysis can also be used for the projection of an economic activity and can be useful for impact analysis.

Input-output analysis however, has its disadvantages, stemming from its underlying assumptions. Firstly, an input-output model is static and linear. It also assumes constant returns to scale, i.e., it does not take into consideration economies of scale. It also assumes fixed production coefficients and assumes that there are no supply constraints such that the intermediate and household sectors will be able to service any increases in final demand.

Notwithstanding these limitations, input-output models is still an important tool that can provide insights as to the economic impacts of an activity including the flow-on effects; hence a useful tool for development planning. The input-output approach can provide a detailed picture of the structure of the economy at a particular point in time (Fuller and Wilde 2006). Once constructed, it can generate interregional multipliers. The model can then be used to simulate the effects of an activity, taking into account the backward and forward linkages generated by that activity.

2. Objectives

The main objective of the research was to determine the structure of the desert economy. Specifically, the study aimed to

- determine the contribution of various sectors operating in the desert to the regional economy.
- estimate the value of employment, income, regional output and value added by desert regions
- examine the multiplier impacts of various sectors to determine which industry sector has the greatest potential impact on income, employment and output in the desert.

3. Methodology

This study used a regional input-output approach. I-O models use an I-O table or matrix showing the flow of transaction between the individual sectors of an economy over a certain period of time. The I-O table, also known as the transaction table (because it shows the inter-sectoral transactions within an economy, and in some cases with the outside world), is made up of four quadrants, namely: (i) intermediate

quadrant, (ii) final demand quadrant, (iii) primary inputs quadrant, (iv) primary inputs for final demand quadrant.

The intermediate quadrant shows the economic interdependence among the producing sectors of an economy. This is particularly important when measuring the effects of a change in output levels of one sector on the output, income or employment levels of the other sectors. The final demand quadrant, on the other hand records the distribution of the output of each sector to the final use of goods and services within the economy. The role of the primary inputs quadrant is to illustrate the source of primary inputs by sector and the income earned by each primary factor of production from each sector. Finally, the primary input to final demand quadrant records those transactions which directly link the primary inputs and final demand quadrant without transmission through the production system or intermediate quadrant (Jensen and West, 1986).

The study used REMPLAN, a regional economic analysis software developed originally at La Trobe University and further developed by a commercial company. The REMPLAN model includes 109 industry sectors. The regions are defined by single or combinations of local government areas. Data used are from the ABS national tables supplemented by selective surveys for key sectors within the region.

The classification of desert regions was based on Brown et al. (2008). The model provides input-output matrices at three levels of sector aggregation (17 sectors, 35 sectors and 109 sectors), using the ABS classification. The model then generates the output, gross regional product, employment, value-added and regional imports and exports. It can also be used to model impacts of direct changes in output or employment, generating impact multipliers.















4. Results and discussion

4.1 Structure of the desert economy

The results of the analysis showed that the output or gross revenue generated by businesses and organisations in Australia's desert regions is about \$90.5 billion. The gross regional product (or in other words, the total value of final goods and services produced in the desert) is about \$45 billion. The per capita gross regional product in the desert is about 1.5 times more than that of the national figure (at \$80,360 compared to \$52,700).

The structure of the desert economy can be gleaned from Table 1. The major contributors to the total output in desert Australia are the mining sector, followed by the manufacturing sector and agriculture, forestry and fishing. As shown in Table 1, the mining sector contributes about 39.5% of total output of the desert economy, while the manufacturing sector contributes about 12.6% and agriculture, forestry and fishery (9.3%).

Table 1: Summary of contribution by each industry sector in Australia's Desert Regions

Summary		Output \$m	Employment Jobs	Wages and Salaries \$m	Local Sales \$m	Regional Exports \$m	Local Expend \$m	Regional Imports \$m	Value Added \$m
	Agriculture Forestry Fishing	\$8,423.603 9.3 %	31,822 13.3 %	\$719.696 4.4 %	\$1,695.608 8.0 %	\$6,109.801 11.9 %	\$1,567.843 7.4 %	\$1,865.059 7.1 %	\$4,990.701 11.6 %
	Mining	\$35,738.713 39.5 %	27,255 11.4 %	\$3,976.971 24.1 %	\$4,084.396 19.2 %	\$31,477.992 61.5 %	\$3,454.947 16.2 %	\$13,745.778 52.3 %	\$18,537.989 43.2 %
	Manufacturing	\$11,419.390 12.6 %	16,149 6.8 %	\$1,314.902 8.0 %	\$4,107.875 19.3 %	\$5,709.144 11.1 %	\$4,860.969 22.8 %	\$3,903.754 14.9 %	\$2,654.668 6.2 %
	Electricity, gas & water supply	\$1,863.576 2.1 %	2,464 1.0 %	\$269.161 1.6 %	\$830.279 3.9 %	\$536.775 1.0 %	\$517.339 2.4 %	\$340.543 1.3 %	\$1,005.694 2.3 %
	Construction	\$5,884.122 6.5 %	13,767 5.8 %	\$769.236 4.7 %	\$1,695.645 8.0 %	\$1,488.097 2.9 %	\$2,594.356 12.2 %	\$1,470.008 5.6 %	\$1,819.758 4.2 %
	Wholesale trade	\$3,026.651 3.3 %	8,568 3.6 %	\$731.247 4.4 %	\$1,140.559 5.4 %	\$335.347 1.8 %	\$1,092.949 5.1 %	\$792.663 3.0 %	\$1,141.039 2.7 %
	Retail trade	\$2,605.643 2.9 %	26,321 11.0 %	\$779.271 4.7 %	\$335.343 1.6 %	\$246.091 0.5 %	\$301.868 4.2 %	\$434.230 1.7 %	\$1,269.545 3.0 %
	Repairs	\$750.765 0.8 %	3,131 1.3 %	\$294.267 1.8 %	\$379.527 1.8 %	\$92.313 0.2 %	\$185.057 0.9 %	\$207.892 0.8 %	\$357.816 0.8 %
	Accommodation, cafes & restaurants	\$1,915.134 2.1 %	13,094 5.5 %	\$511.690 3.1 %	\$261.529 1.2 %	\$333.379 1.0 %	\$620.390 2.9 %	\$465.417 1.8 %	\$829.327 1.9 %
	Transport & storage	\$3,362.343 3.7 %	9,516 4.0 %	\$673.333 4.1 %	\$1,499.847 7.0 %	\$1,259.807 2.5 %	\$1,223.027 5.7 %	\$331.659 3.2 %	\$1,307.658 3.0 %
	Communication services	\$710.475 0.8 %	1,681 0.7 %	\$120.629 0.7 %	\$440.293 2.1 %	\$18.539 0.0 %	\$245.233 1.2 %	\$113.111 0.4 %	\$352.130 0.8 %
	Finance & insurance	\$1,128.340 1.2 %	2,954 1.2 %	\$354.548 2.1 %	\$609.092 2.9 %	\$154.698 0.3 %	\$244.070 1.1 %	\$130.117 0.5 %	\$754.153 1.8 %
	Property & business services	\$4,461.370 4.9 %	12,908 5.4 %	\$1,088.563 6.6 %	\$3,468.960 16.3 %	\$494.979 1.0 %	\$1,851.609 8.7 %	\$601.373 2.3 %	\$2,008.389 4.7 %
	Government administration & defence	\$3,382.575 3.7 %	15,555 6.5 %	\$1,456.448 8.8 %	\$278.239 1.3 %	\$1,212.016 2.4 %	\$331.072 4.4 %	\$715.868 2.7 %	\$1,735.635 4.0 %
	Education	\$1,946.058 2.2 %	18,409 7.7 %	\$1,301.400 7.9 %	\$141.121 0.7 %	\$349.376 0.7 %	\$267.146 1.3 %	\$204.399 0.8 %	\$1,474.513 3.4 %
	Health & community services	\$2,283.324 2.5 %	24,413 10.2 %	\$1,433.483 8.7 %	\$34.504 0.2 %	\$360.678 0.7 %	\$270.273 1.3 %	\$196.309 0.7 %	\$1,816.743 4.2 %
	Cultural & recreational services	\$665.634 0.6 %	2,587 1.1 %	\$135.658 0.8 %	\$221.092 1.0 %	\$18.535 0.0 %	\$261.174 1.2 %	\$121.861 0.5 %	\$182.599 0.4 %
	Personal & other services	\$997.673 1.1 %	7,969 3.3 %	\$590.295 3.6 %	\$35.865 0.3 %	\$217.474 0.4 %	\$200.450 0.9 %	\$129.915 0.5 %	\$667.308 1.6 %
Total		\$80,465.390	238,563	\$16,520.796	\$21,289.775	\$51,215.041	\$21,289.775	\$26,269.954	\$42,905.662

In terms of labour and employment, the total employment in the area is estimated at about 238,563 jobs with the agriculture, forestry and fishing; retail trade; and mining as the main contributors to employment. The total wages and salaries paid to employees who work in Australia's desert regions is about \$16.5 billion, or a per capita average income of \$69,252.

In terms of value-adding, the total value-added by industry sectors in Australia's desert regions to intermediate inputs is estimated at about \$42.9 billion, with mining; agriculture, forestry and fishing; and manufacturing as the major contributors to value-added.

The total goods and services produced in Australia's desert regions that were sold to local industry sectors as inputs into production and for value-adding (local sales) is about \$21.3 billion, with manufacturing at 4.1b (19.3%), mining at 4.18b (19.2%) and property & business services at 3.5b (16.3%) as the top industry sectors. (Figure 1).

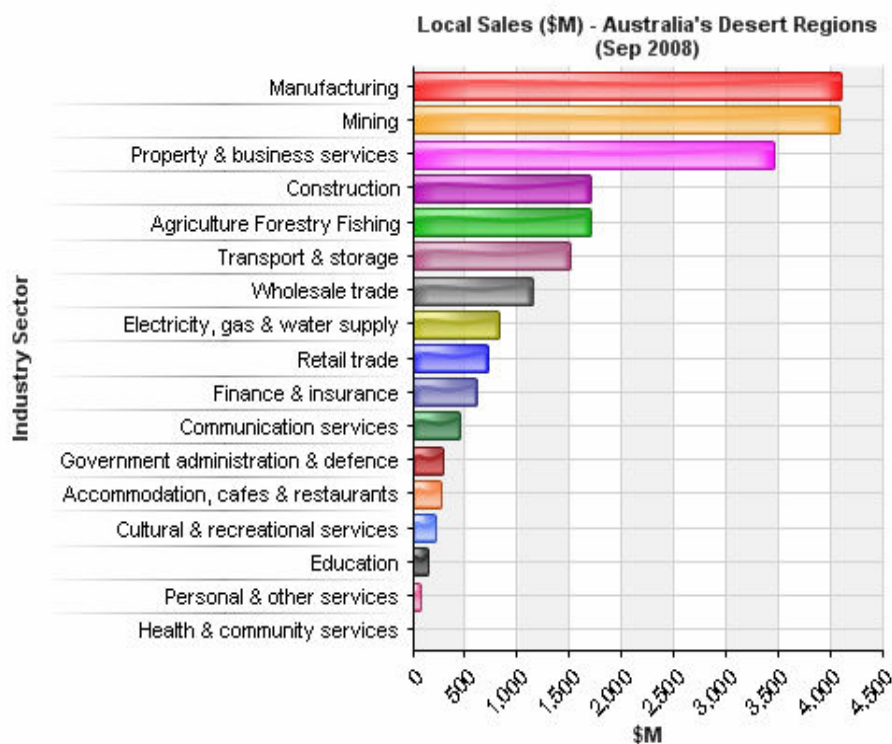


Figure 1: Local sales in Desert Australia

On the other hand, the total regional export estimate for Australia's desert regions is about \$51.2 billion, whereas the total regional import estimate is \$26.3 billion.

As can be seen from the above results, currently, the desert relies mainly on only a few industry sectors in delivering its output. About 60% of the gross revenue of the desert comes from only three sectors - mining, manufacturing and agriculture. Likewise, mining; agriculture, & forestry & fishery and manufacturing provide the highest contributions to income and value added; while agriculture, & forestry & fishery; retail and mining provide the highest contributions to employment.

This overdependence on only a few industry sectors can be a risky proposition. For example, an outbreak of foot-and mouth disease may impact heavily on the pastoral industry with dire consequences on employment and income of people residing in the desert. Similarly, global financial crises may affect the demand for commodities including agriculture and mining, again potentially having a major effect on output, employment and income in the region.

4.2 Mitigating the risks - identifying high impact sectors

How can desert economies mitigate risks associated with over-reliance on a few select sectors and ensure continued growth in the long run? One way is by identifying the potential high impact sectors. Determining the sectors that will have the greatest backward and forward linkages and hence, ripple effects can provide valuable information on what sectors to target for investment or economic development.

The results of the analysis showed that industries that provide the highest impact multipliers on output are culture & recreation, property & business services, and construction (Table 2).

Table 2: Impact multiplier for total output

	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Cultural & recreational services	\$1.00	\$0.74	\$0.36	\$2.10	1.739	2.101
Property & business services	\$1.00	\$0.67	\$0.35	\$2.02	1.67	2.021
Construction	\$1.00	\$0.73	\$0.25	\$1.98	1.729	1.981
Government administration & defence	\$1.00	\$0.42	\$0.48	\$1.90	1.424	1.902
Personal & other services	\$1.00	\$0.31	\$0.59	\$1.90	1.307	1.9
Wholesale trade	\$1.00	\$0.58	\$0.32	\$1.90	1.576	1.899
Retail trade	\$1.00	\$0.51	\$0.39	\$1.90	1.512	1.898
Transport & storage	\$1.00	\$0.57	\$0.30	\$1.86	1.567	1.862
Education	\$1.00	\$0.21	\$0.64	\$1.85	1.205	1.85
Accommodation, cafes & restaurants	\$1.00	\$0.50	\$0.32	\$1.83	1.504	1.827
Manufacturing	\$1.00	\$0.63	\$0.19	\$1.82	1.625	1.816
Communication services	\$1.00	\$0.55	\$0.26	\$1.80	1.545	1.8
Health & community services	\$1.00	\$0.18	\$0.60	\$1.78	1.177	1.776
Finance & insurance	\$1.00	\$0.34	\$0.37	\$1.70	1.337	1.703
Electricity, gas & water supply	\$1.00	\$0.41	\$0.20	\$1.61	1.413	1.613
Agriculture Forestry Fishing	\$1.00	\$0.26	\$0.11	\$1.37	1.259	1.369
Mining	\$1.00	\$0.12	\$0.12	\$1.24	1.115	1.236

In terms of employment, manufacturing and construction are the sectors with the highest multipliers (Table 3). As shown in the table, manufacturing has a type 1 multiplier of 2.01 and a type 2 multiplier of 2.73, while construction has 1.99 and 2.56 type 1 and type 2 multipliers, respectively. Type 1 multipliers include the direct effects plus the industrial effects (i.e., the impact generated within the region). Type 2 multipliers include the direct effect plus the industrial effects plus the consumption effects.

Table 3: Impact multipliers for employment

	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Manufacturing	1	1	1	4	2.01	2.713
Construction	2	2	1	6	1.997	2.556
Electricity, gas & water supply	1	1	1	3	1.763	2.547
Property & business services	3	2	2	7	1.668	2.298
Communication services	2	2	1	5	1.678	2.24
Wholesale trade	3	2	2	6	1.558	2.151
Transport & storage	3	2	2	6	1.585	2.127
Finance & insurance	3	1	2	5	1.336	2.062
Cultural & recreational services	5	2	2	9	1.529	1.94
Government administration & defence	5	1	2	8	1.306	1.846
Personal & other services	8	1	3	12	1.13	1.515
Accommodation, cafes & restaurants	7	2	2	10	1.23	1.475
Education	9	1	3	14	1.082	1.436
Retail trade	9	2	2	12	1.189	1.418
Health & community services	11	1	3	14	1.062	1.353
Agriculture Forestry Fishing	4.000	1.000	1.000	5.000	1.194	1.347
Mining	1.000	0.000	1.000	2.000	0.000	0.000

The high impact sectors on wages and salaries are construction, manufacturing and cultural & recreation, with 2.71, 2.3 and 2.1 type 2 multipliers respectively (Table 4). Finally, in terms of value-adding, culture & recreation (2.48), manufacturing (2.45) and construction (2.32), have the highest flow-on effects in the region (Table 5).

Table 4: Impact multipliers for wages & salaries

	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Construction	\$0.13	\$0.15	\$0.07	\$0.35	2.165	2.709
Manufacturing	\$0.12	\$0.10	\$0.05	\$0.27	1.865	2.334
Cultural & recreational services	\$0.24	\$0.17	\$0.10	\$0.51	1.695	2.121
Communication services	\$0.17	\$0.12	\$0.07	\$0.36	1.692	2.117
Transport & storage	\$0.20	\$0.13	\$0.08	\$0.42	1.655	2.071
Property & business services	\$0.24	\$0.15	\$0.10	\$0.49	1.616	2.022
Electricity, gas & water supply	\$0.14	\$0.08	\$0.06	\$0.28	1.551	1.941
Wholesale trade	\$0.24	\$0.12	\$0.09	\$0.45	1.502	1.879
Agriculture Forestry Fishing	\$0.09	\$0.04	\$0.03	\$0.16	1.456	1.822
Accommodation, cafes & restaurants	\$0.27	\$0.10	\$0.09	\$0.45	1.358	1.698
Retail trade	\$0.32	\$0.11	\$0.11	\$0.54	1.356	1.697
Finance & insurance	\$0.31	\$0.10	\$0.10	\$0.51	1.308	1.637
Government administration & defence	\$0.43	\$0.11	\$0.14	\$0.67	1.247	1.56
Mining	\$0.11	\$0.03	\$0.03	\$0.17	1.221	1.528
Personal & other services	\$0.59	\$0.07	\$0.17	\$0.83	1.125	1.408
Education	\$0.67	\$0.06	\$0.18	\$0.91	1.082	1.354
Health & community services	\$0.63	\$0.05	\$0.17	\$0.84	1.071	1.34

Table 5: Multiplier effects on value-added

	Direct Effect	Industrial Effect	Consumption Effect	Total Effect	Type 1 Multiplier	Type 2 Multiplier
Cultural & recreational services	\$0.32	\$0.31	\$0.17	\$0.80	1.951	2.479
Manufacturing	\$0.23	\$0.25	\$0.09	\$0.57	2.058	2.446
Construction	\$0.31	\$0.29	\$0.12	\$0.72	1.94	2.324
Wholesale trade	\$0.38	\$0.25	\$0.15	\$0.78	1.652	2.056
Property & business services	\$0.45	\$0.30	\$0.17	\$0.91	1.661	2.029
Transport & storage	\$0.39	\$0.24	\$0.14	\$0.76	1.606	1.964
Accommodation, cafes & restaurants	\$0.43	\$0.20	\$0.15	\$0.79	1.472	1.823
Retail trade	\$0.49	\$0.22	\$0.18	\$0.88	1.444	1.82
Government administration & defence	\$0.51	\$0.18	\$0.23	\$0.92	1.358	1.798
Communication services	\$0.50	\$0.23	\$0.12	\$0.85	1.462	1.705
Personal & other services	\$0.67	\$0.13	\$0.28	\$1.08	1.2	1.618
Education	\$0.76	\$0.10	\$0.30	\$1.16	1.126	1.527
Electricity, gas & water supply	\$0.54	\$0.19	\$0.09	\$0.82	1.351	1.525
Finance & insurance	\$0.67	\$0.16	\$0.17	\$1.00	1.242	1.5
Health & community services	\$0.80	\$0.08	\$0.28	\$1.16	1.101	1.455
Agriculture Forestry Fishing	\$0.59	\$0.12	\$0.05	\$0.77	1.206	1.294
Mining	\$0.52	\$0.05	\$0.06	\$0.63	1.102	1.212

This results above show which industry sectors are likely to provide the highest multiplier impacts on the economy with implications on strategic investments directions for industry sectors that are likely to have a high impact on output, employment and income in desert regions in Australia.

5. Summary, conclusion and policy implications

The study showed that mining; manufacturing; agriculture, & forestry & fishery provide the highest contributions to output; while agriculture, & forestry & fishery; retail and mining provide the highest contributions to employment. Likewise, mining; agriculture, & forestry & fishery and manufacturing provide the highest contributions to income and value added. This shows that the desert seems to be highly dependent on only a few industry sectors. This can be a risky proposition in light of climate change, increasing interconnectedness of financial markets and the fact that the resources boom is unlikely to be an on-going phenomenon. Already, the current financial crisis is impacting in the mining sector, with subsequent cuts in employment amongst several mining companies.

It is worthy to note that the highest contributor to output may not necessarily have the highest multiplier effects. For example, while the percentage contribution of cultural & recreational services relative to the other sectors is low, the multiplier effects on output, wages & salaries & value-added are high, which means their impact locally are high. Industries that provide the highest impact multipliers on output are culture & recreation, property & business services, and construction. In terms of employment,

manufacturing and construction are the sectors with the highest multipliers; while the high impact sectors on for wages and salaries are construction, manufacturing and cultural & recreation. Finally, in terms of value-adding, cultural & recreation, manufacturing, and construction have the highest flow-on effects in the region. This is because these industries have well developed local supply chains, so increases in output will generate flow-on effects in the local economy.

These findings have implications on targeting areas for investment. Regional economic development strategies need to focus on areas that have high multiplier effects on the local economy. From a regional point of view, sectors that procure locally are likely to have the highest impact. So are supporting industries that will engage in value-adding within the region. For instance, a recent study by McGregor et al (2008) has identified problems in relation to the camel population in the desert. If an abattoir or processing plant is built, the impacts of locating this facility in the desert needs to be investigated to determine potential impacts on employment and other indicators. It is also important to support enterprise development of small business surrounding cultural and recreation including tourism and arts in desert areas. Private sector participation is instrumental in promoting development both at the social and economic levels. As pointed by Salem (2008), increased productivity and investment done by the private sector are key determinants of economic growth. In the desert, where many cultural and recreational enterprises and micro or small-scale, such investments are likely to have a significant effect on employment and incomes.

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