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EDITED BY

PAUL DALZIEL

ROLF GERRITSEN

DELWAR AKBAR

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Preface

The 43rd Annual Conference of the Australian and New Zealand Regional Science Association International (ANZRSAI) was held at the Central Queensland University, Cairns from 4 to 6 December 2019. A broad range of papers from academics, policy advisors and practitioners were presented to the conference. This publication contains the refereed proceedings of those contributed papers.

Participants who submitted their full paper by the due date were eligible to be considered for these refereed proceedings. There were twelve papers submitted to a double-blind refereeing process, all of which were accepted for presentation in this publication. We are very grateful to referees for their work within a short timeframe.

Three awards were presented at the conference dinner. The John Dickinson Memorial Award for best article in the *Australasian Journal of Regional Science* 2019 was awarded to Lisa Denny for her article "Economic Restructuring and the Polarisation of the Workforce: A Regional Perspective" published in volume 25 (1), pp. 4-25.

The ANZRSAI Award for Best Conference Paper 2019 was awarded to Robert J Stimson and Alistair Robson for their paper "Endogenous Employment Performance of Non-Metropolitan Regions Across Australia 2006-16". This paper is the first paper presented in these proceedings. The committee also awarded two other entrants as highly commended conference paper: Azad Rahman, Delwar Akbar and John Rolfe for their paper "Every community wants an airfreight facility: Is this a viable regional agricultural supply chain development option for Central Queensland?"; and Vince Mangioni for his paper "Land Acquisition at the Urban Fringe: Assessing Compensation for Infrastructure Projects".

The ANZRSAI Award for Best Conference Paper by a Current or Recent Student 2019 was awarded to Md Zillur Rahman for his paper co-authored with Yogi Vidyattama, Delwar Akbar and John Rolfe "Spatial and Temporal Contexts of Changes in Median House Prices in Australian Metropolitan Cities: A Case Study of the West of Melbourne".

We thank all the participants for their involvement in our 43rd Annual Conference, particularly those who had travelled some distance from overseas to attend. The international community of regional science scholars is strengthened when people gather to share their research and expertise at conferences such as this. We also acknowledge the contribution of Dr Azad Rahman for his support on compiling the conference proceedings.

Paul Dalziel, Rolf Gerritsen and Delwar Akbar

Editors, 43rd Annual ANZRSAI Conference Proceedings

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Endogenous Employment Performance of Non-Metropolitan Functional Economic Regions Across Australia, 2006-2016

Robert J. Stimson[1] and Alistair Robson[2]

[1] University of Queensland and University of Melbourne

[2] The University of New South Wales

Email: rstimson@unimelb.edu.au

ABSTRACT

Regional development has been an issue of considerable policy concern for regional Australia for some decades, as it is evident that some regions perform well while others lag or are in decline. This paper addresses the endogenous employment performance of Functional Economic Regions (FERs) that are located beyond the big capital city metropolitan regions across what is referred to as 'regional Australia'. The analytic tool Shift-Share Analysis (S-SA) is used to derive a measure of endogenous regional employment performance across the decade 2006-2016 The regional (or differential) shift component in the S-SA is used as a surrogate measure of that performance, revealing wide spatial variation in the patterns of endogenous employment performance across regional FERs. Regression modelling is used to identify factors that might explain the evident spatial variations in that performance. Finally, implications of the findings for regional development policy are discussed.

Key words: Functional regions; endogenous growth; modelling regional performance.

INTRODUCTION

Regional development is an issue of considerable policy concern for regional Australia and has been for some decades as it is evident that some regions perform well while others lag or are in decline. This paper addresses the *endogenous employment performance* of *Functional Economic Regions* (FERs) that are located beyond the big capital city metropolitan regions across what is referred to as 'regional Australia'.

The analytic tool *Shift-Share Analysis* (S-SA) is used to derive a measure of endogenous regional employment performance across the decade 2006-2016. The *regional (or differential) shift component* in the S-SA is used as a surrogate measure of that performance, revealing wide spatial variation in the patterns of endogenous employment performance across regional FERs. Regression modelling is used to identify factors that might explain the evident spatial variations in that performance. Finally, implications of the findings for regional development policy are discussed.

BACKGROUND

For many years now following the emergence of the *New Growth Theory* (NGT) there has been

an increasing emphasis on investigating the role of *endogenous* factors and processes as drivers in regional economic development, the being that a region's growth is influenced substantially by the internal characteristics of a region which includes factors such as its resource endowments, population size, industrial structure, human capital, social capital, institutions and entrepreneurship.

But relatively few model frameworks have been developed and applied that actually propose a measure of endogenous regional performance as a dependent variable and which propose measures for those factors that are hypothesised as independent variables that might explain spatial variations in that endogenous performance of regions across a country, which is not always straight forward.

One approach is that the model framework proposed by Stimson, Stough and Salazar (2005) and Stimson and Stough (with Salazar) (2009) which has been applied in Australia in a series of studies investigating endogenous regional employment performance which have been undertaken by the authors and their collaborators. In those investigations the regional or differential shift component in a Shift-Share Analysis of changes in regional employment over a decade period has been used as a surrogate measure of endogenous regional performance, with regression modelling being used to identify potential factors which might explain spatial variations in that performance.

The modelling framework was initially applied to investigate regional employment performance across non-metropolitan Local Government Areas (LGAs) in Queensland for the decade 1996-2006 (Stimson, Robson and Shyy 2009), and that was followed by an investigation of the performance of regional LGAs across all of Australia for that decade (Stimson, Rohde and Shyy, 2009).

Subsequently, a new national geography of *Functional Economic Regions* (FERs) was used as the spatial base to investigate endogenous regional employment performance across Australia - incorporating both metropolitan FERs and non-metropolitan FERs - for the decade 1996-2006 (Stimson, Mitchell, Rohde and Shyy, 2011), and then for the decade 2001-2011 (Stimson, Flanagan Mitchell, Shyy and Baum, 2018).

More recently, that modelling has been replicated in an analysis of endogenous regional employment performance of FERs across all of Australia for the decade 2006-2016 in a paper that also investigates the degree of consistency over time across three overlapping decades - 1996-2006, 2001-2011 and 2006-2016 - in the factors that are statistically significant in potentially explaining the spatial variations in the endogenous regional employment performance of FERs across Australia (Stimson and Robson, forthcoming).

The current paper now uses the same modelling approach as that used in the above investigations, but with an explicit focus on FERs across regional Australia - that is, in FERs beyond the major capital city metropolitan areas.

THE DATA AND MODELLING APPROACH

A functional economic regions spatial data base

The spatial base for the investigation of endogenous regional employment performance across FERs that are located beyond the major capital city metropolitan areas (that is, outside Sydney, Melbourne, Brisbane, Adelaide and Perth) used in this paper are *functional* regions that were derived from census journey-to-work data using the *Intramax* methodology proposed by Masser and Brown (1975) and which has been adopted in Australia by Mitchell and Flanagan

(2009) and Mitchell and Watts (2010) to create a new national functional regional geography.

Using a spatial data base of *functional* regions rather that *de jure* regions based on LGAs is more desirable when undertaking spatial econometric analysis as *functional* regions helps address the spatial autocorrelation issued that is encountered when using *de jure* regions as a spatial base. Stimson, Mitchell, Rohde and Shyy (2011) demonstrate that to be the case when using FERs in Australia.

In the current paper the FERs used are those demarcated by Stimson, Mitchell, Flanagan, Baum and Shyy (2016) which were derived by applying the *Intramax* methodology to the 2011 census journey-to-work data at the Statistical Area 2 (SA2s) level, which are the building blocks used for demarcating the FERs. For our purpose in this paper focusing on the regions beyond the major capital city metropolitan areas we use 110 FERs that are located across what is referred to as 'regional Australia'.

The data variables

Table 1 lists the variables used in the modelling reported in the current paper.

Following the framework proposed by Stimson, et al. (2009), the modelling approach uses as the *dependent variable* a surrogate measure of *endogenous regional employment performance over time* which is the *differential (or regional) component* derived from a Shift-Share Analysis of regional employment change over the decade 2006-2016, standardised by the size of the regional labour force at the beginning of the period [REG_SHIFT_06-16]. The score of a region on that measure of endogenous regional employment performance may be *positive* of *negative*. A *positive* score indicates there are factors and processes within a region that are advantageous enhancing employment growth to a level that is over and beyond that which may be attributable to national and industry mix effects. Conversely, a *negative* score indicated that a region has factors and processes that are disadvantageous or detrimental holding back employment growth or even resulting in decline.

A set of *independent variables* for the110 FERs have been derived largely from the 2006 and 2016 censuses, but also include some locational attributes of FERs. They represent potential variables that might explain the spatial variation occurring in the dependent variable performance of non-metropolitan FERs across Australia for the decade 2006-2016.

The independent variables derived from the census relate to both static and dynamic measures of the following:

- population size and change;
- the degree of specialisation and diversity of employment in industry sector; a structural change index;
- the incidence of unemployment;
- measures of concentration of employment in industry sectors and in some broad occupation categories;
- a range of measures of human capital;
- a surrogate of social capital measured by the incidence of volunteering.

The locational variables relate to:

- being a remote region;
- being an urban region;

- proximity to the coast; and

- being adjacent to a metropolitan area

Table 1: Variables used: The Dependent Variable and the Independent Variables

	Variable description
Dependent variable	
REG_SHIFT_06-16	Regional Shift (2006 to 2016) / Labour Force (2006)
Explanatory variables	
Census data derived	
SPEC_06	Specialization Index for 2006 (Herfindahl-Hirschman Index)
SPEC_CH	Change in Specialization Index from 2006-2016 (Herfindahl-Hirschman Index)
SCI	Structural Change Index 2006-2016
SCI_CH	Change in the Structural Change Index 2006-2016)
L_INC_06	(Approximate) Mean Individual Income in 2006 Annual (Log) (real)
L_INC_CH	Change in (Approximate) Mean Individual Income 2006-2016 Annual (Log) (real)
UNEMP_06	Unemployment rate in 2006 (%)
UNEMP_CH	Change in Unemployment Rate 2006-2016 (percentage points)
L_POP_06	Log of Population in 2006
L_POP_CH	Change in Log of Population 2006-2016
LQ_MAN_06	Location Quotient for the Manufacturing Industry in 2006
LQ_INF_06	Location Quotient for the Information, Media & Telecommunications Industry in 2006
LQ_FIN_06	Location Quotient for the Financial & Insurance Services Industry in 2006
LQ_PRO_06	Location Quotient for the Professional, Scientific & Technical Services Industry in 2006
LQ_MAN_CH	Change in the Location Quotient for the Manufacturing Industry, 2006-2016
LQ_INF_CH	Change in the Location Quotient for the Information, Media & Telecommunications Industry 2006-2016
LQ_FIN_CH	Change in the Location Quotient for the Financial & Insurance Services Industry, 1996-2006-2016
LQ_PRO_CH	Change in the Location Quotient for the Professional, Scientific & Technical services Industry,2006-2016
POSTGRAD_06	Proportion of labour force with a Postgraduate Degree in 2006
BACHELOR_06	Proportion of labour force with a Bachelor Degree in 2006
TECHQUALS_06	Proportion of labour force with Technical Qualifications in 2006
POSTGRAD_CH	Change in the Proportion of labour force with a Postgraduate Degree 2006-2016
BACHELOR_CH	Change in the Proportion of labour force with a Bachelor Degree in 2006-2016
TECHQUALS_CH	Change in the Proportion of labour force with Technical Qualifications 2006-2016
SYMBA_06	Proportion of Symbolic Analysts (Managers + Professionals) Occupations in 2006
SYMBA_CH	Change in the proportion of Symbolic Analysts (Managers + Professionals) 2006-2016
VOLUNTEER_016	Proportion of Volunteers in Working Age Population (15-64) in 2016
Locational Variables	
A_COAST	FER border is adjacent to coastline (No = 0; Yes = 1)
P_METRO	FER border is adjacent to a metropolitan statistical division (No = 0; Yes = 1)
D_URBAN	Classified as Urban under Australian Classification of Local Government system (1 = Yes, 0 = No)
D_REMOTE	Classified as Remote under Australian Classification of Local Governments system (1 = Yes, 0 = No)

Source: The authors.

The *independent (or explanatory) variables* used to investigate potential factors that might explain variation in the endogenous employment performance of FERs across regional Australia (the dependent variable) are the same set of 32 variables used in the previous studies cited earlier.

The modelling

Regression modelling is used to investigate the potential factors that might explain the spatial variation in the performance of the regional FERs on the dependent variable relating to endogenous regional employment performance over the decade 2006-2016.

Two models are run:

- first, an *Ordinary Least Squares* procedure is used to derive a *general model*; and

- second, a *Backward Stepwise* procedure is used to derive a *specific model*.

RESULTS

The endogenous regional employment performance of FERs

The performance of the 110 non-metropolitan FERs across regional Australia on the *dependent variable* measuring endogenous regional employment performance over the decade 2006-2016 is widely variable. Not unexpectantly, the incidence of *negative* performance on the dependent variable is widespread and quite pervasive across regional Australia occurring in 98 (89%) of the FERs. The performance is *positive* in only 12 (11%) of the FERs. The top twenty *positive* performers and the bottom twenty *negative* performers are listed in Tables 2 and 3.

Table 2: Top 20 ranking FERs on the endogenous regional employment performance measure

Rank	Top 20 FERs	State	REG_SHIFT_06-16
1	Gold Coast - Tweed	NSW & QLD	18,713
2	Sunshine Coast	QLD	11,235
3	Palmerston - Litchfield	NT	8,911
4	Geelong - Surf Coast	Vic	5,507
5	Ashburton	WA	4,564
6	Port Hedland - Newman - East Pilbara	WA	3,267
7	Bunbury - Margaret River	WA	3,181
8	Darwin City - Inner suburbs	NT	3,122
9	Karratha - Roebourne	WA	1,156
10	Weipa	QLD	248
11	Thamarrurr	NT	34
12	Ballarat and surrounds	Vic	20
13	Western	SA	-25
14	Petermann - Simpson	NT	-56
15	Anindilyakwa	NT	-146
16	Coober Pedy	SA	-165
17	Daly - Alligator	NT	-245
18	King Island	Tas	-275
19	Meekatharra	WA	-280
20	Tennant Creek - Barkly	NT	-295

Source: The authors

Of the top 20 ranking FERs (Table 2) only 12 have a *positive* endogenous regional employment score performance. They are a very mixed group:

- The top highest performing FERs are adjacent to metro areas - Gold Coast-Tweed and Sunshine Coast to the south and north of Brisbane, Palmerston-Litchfield to the south of Darwin, and Geelong and Geelong-Surf Coast adjacent to the south-west of Melbourne. Darwin City-Inner Suburbs FER is also positive, as are Bunbury-Margaret River to the south of Perth and Ballarat and Surrounds to the west of Melbourne.

- Oher FERs with a positive performance are largely a mix of:
  - mining regions, such as Ashburton, Port Headland-Newman-East Pilbara, and Karratha-Roehorne, and Meekatherra in Western Australia, Coober Pedy in South Australia, and Weipa in Queensland; and
  - indigenous communities in Western Australia and the Northern Territory, with the latter an anomaly as recipients of substantial federal government funding for employment generation projects so that positive performance is artificial.

- Other regional FERs with a positive performance are Western in South Australia, Tenant Creek-Barkly in the Northern Territory, and King Island off Tasmania.

Table 3: Bottom twenty ranking FERs on the endogenous regional employment performance measure

Rank	Bottom 20 FERs	State	REG_SHIFT_06-16
91	Mildura and surrounds	Vic	-4,163
92	Whyalla - Port Augusta - Outback SA	SA	-4,170
93	Northern Darwin suburbs	NT	-4,335
94	Moree - Inverell - Goondiwindi	NSW	-4,529
95	Lithgow - Bathurst - Orange	NSW	-4,563
96	Ararat - Horsham	Vic	-4,657
97	Latrobe Valley - Sale	Vic	-4,741
98	Dubbo - Nyngan - Coonabarabran	NSW	-4,747
99	Colac - Warrnambool	Vic	-4,845
100	Devonport - Burnie - Wynyard	Tas	-5,048
101	South Eastern SA - West Wimmera	SA	-5,629
102	Newcastle - Lake Macquarie - Hunter Valley	NSW	-5,872
103	Swan Hill - Deniliquin - Wentworth	Vic	-6,139
104	Richmond Valley	NSW	-6,313
105	Launceston and surrounds	Tas	-6,454
106	Rockhampton - Emerald	Qld	-6,826
107	Mackay - Whitsunday	Qld	-7,015
108	Wagga Wagga - Young	NSW	-7,552
109	Shepparton - Euchuca - Jerilderie	Vic	-8,211
110	Albury - Wangaratta - Benalla	NSW	-11,338

Source: The authors

The 20 FERs with the worst *negative* performance on the endogenous regional employment measure (Table 3) are widely spread across regional Australia. They include:

- FERs spread widely across the inland wheat-sheep belt, including:

  o Swan-Hill-Deniliquin-Wentworth and Albury-Wangaratta-Benalla straddling the Victoria-New South Wales border;

  o South-East ern SA-West Wimmera straddling the Victoria-South Australia border;

  o Wagga-Young, Dubbo-Nyngan-Coonabarabran, and Lithgow-Bathurst-Orange in New South Wales;

  o Moree-Inverell-Goondiwindi straddling the New South Wales-Queensland border.

- Some coastal areas such as La Trobe Valley-Sale in Victoria, Richmond Valley in New South wales and Mackay and Rockhampton-Emerald in Queensland.

- Launceston and Surrounds and Devonport-Burnie-Wynyard in Tasmania.

- The industrial regional FER of Whyalla-Port Augusta-Outback SA in South Australia.

- The Newcastle-Lake Macquarie-Hunter Valley region to the north of Sydney.

- The Northern Darwin Suburbs in the Northern Territory.

However, it is evident that spread widely across regional Australia there are many FERs with relatively low negative scores on the endogenous regional employment performance measure.

Thus, we might conclude the following:

1. It is only a handful of regional FERs for which it might be claimed there are factors and processes endogenous to the region that have *enhanced* employment growth over the decade 2006-2016 at a level that is over and above employment growth that can be attributable to national and industry mix effects. Those factors or processes are *advantageous* and help drive employment growth.

2. Conversely, overwhelmingly across regional Australia's FERs over the decade 2006-2016 it seems there are endogenous factors and processes that are *disadvantageous* or *detrimental* holding back employment growth or even exacerbating a decline.

Results of the regression modelling

Regression modelling is used to identify factors that might be significant in *explaining* the considerable variation evident in the performance of FERs across regional Australia over the decade 2006-2016 in the dependent variable [REG_SHIFT_06-16].

It was decided to remove from the regression analyses a small number of FERs[1] that are outliers, which is the recommended practice. However, we also ran the models including those outlier FERs. In the discussion that follows the focus is on the models in which the outliers are eliminated, but there is also reference to the results of the models when including the outliers.

A general model

An *Ordinary Least Squares* regression procedure is used to derive a *general model*. The results of the *general model* derived when *excluding the outlier FERs* are provided in Table 4. The

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[1]Those outlier FERs are: Gold Coast – Tweed, Sunshine Coast, Albury - Wangaratta - Benalla, Palmerston - Litchfield; Geelong - Surf Coast; Bunbury - Margaret River.

model produced an adjusted $R^2 = 0.84$, which is relatively high, with seven explanatory variables being significant.

Those variables that are *positive* and are potentially enhancing the endogenous regional employment performance of FERs are:

- the level of population change, 2006-2016 [L_POP_CH];

- the change in the Location Quotient for employment in Financial and Insurance services industries, 2006-2016 [LQ_FIN_CH]; and

- the change in the Location Quotient for employment in Professional, Scientific and Technical Services industries, 2006-2016 [LQ_PRO_CH].

Table 4: General model results (outlier FERs excluded)

Coefficients: (1 not defined because of singularities)

Variable	Estimate	Std. Error	*t* value	Pr(>|t|)	
(Intercept)	2.439e+04	9.018e+03	2.704	0.008638	**
Spec_06	2.358e-01	6.942e-01	0.340	0.735163	
Spec_ch	3.347e-01	8.661e-01	0.386	0.700405	
Sci	-1.209e+02	4.888e+01	-2.472	0.015932	*
Sci_ch	-1.245e+01	3.649e+01	-0.341	0.733959	
L_inc_06	1.157e+03	1.094e+03	1.058	0.294023	
L_inc_ch	4.680e+03	2.670e+03	1.753	0.084120	
Unemp_06	1.865e+02	9.849e+01	1.894	0.062469	
Unemp_ch	-1.022e+02	5.689e+01	1.797	0.076775	
L_pop_06	-4.929e+03	5.454e+02	-9.037	2.9e-13	***
L_pop_ch	2.355e+04	4.136e+03	5.693	2.9e-07	***
Lq_man_06	-6.560e+02	4.730e+02	-1.387	0.170018	
Lq_man_ch	-1.087e+03	7.065e+02	-1.539	0.128452	
Lq_inf_06	7.346e+02	1.179e+03	0.623	0.535259	
Lq_inf_ch	-1.054e+03	1.181e+03	-0.893	0.375011	
Lq_fin_06	-2.418e+02	1.350e+03	-0.179	0.858389	
Lq_fin_ch	8.363e+03	2.509e+03	3.334	0.001390	**
Lq_pro_06	6.420e+03	1.687e+03	3.807	0.000304	***
Lq_pro_ch	6.707e+02	1.870e+03	0.359	0.720976	
Postgrad_06	- 3.013e+04	2.025e+04	-1.488	0.141382	
Postgrad_ch	-1.298e+04	3.459e+04	-0.375	0.708600	
Bachelor_06	-3.010e+04	1.375e+04	-2.189	0.032030	*
Bachelor_ch	-3.140e+04	1.739e+04	-1.805	0.075445	
Techquals_06	-1.349e+04	8.113e+03	-1.663	0.100851	
Techquals_ch	-8.021e+03	1.039e+04	-0.772	0.442664	
Symba_06	-2.479e+03	5.987e+03	-0.414	0.680179	
Symba_ch	3.638e+03	6.701e+03	0.543	0.588918	
Volunteer_16	-2.852e+04	1.088e+04	-2.622	0.010784	*
A_coast	-5.112e+01	2.736e+02	-0.187	0.852333	
P_metro	-2.082e+02	4.233e+02	-0.492	0.624422	
D_urban	-7.488e+01	4.518e+02	-0.166	0.868870	
D_remote	1.313e+03	9.438e+02	1.392	0.168577	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 1094 on 68 degrees of freedom
Multiple R-squared: 0.8405, *Adjusted R-squared:* 0.7677
F-statistic: 11.56 on 31 and 68 *DF*, *p-value:* < 2.2e-16
Source: The authors

Those variables that are *negative* and are associated with being detrimental and not enhancing endogenous regional employment performance of FERs are:

- a region's Structural Change Index, 2006-2016 [SCI];

- the level population in 2006 [L_POP_06];

- the incidence of persons in the work force in 2006 with a Bachelor Degree [BACHELOR_06]; and

- the incidence of Volunteering in 2016 [VOLUNTEER_16].

The *general model* derived when *including the outlier FERs* has an adjusted R^2=0.41. That provides a much lower explanation of the variation in the dependent variable [REG_SHIFT_06-16] than that produced when the model was run eliminating the outlier FERS. And there are some changes in the explanatory variables that are significant.

In particular:

- the variable relating to the Structural Change Index [SCI] is not significant, nor is the incidence of people in the work force with a bachelors degree qualification [BACHELOR_06];

- however, the incidence of people in the work force with a post graduate degree qualification [POSTGRAD_06] becomes significant in with a positive impact, and the incidence of employment in manufacturing industries [LQMAN_06] becomes significant with a negative influence; and

- if a FER is located adjacent to a large capital city metropolitan area becomes significant in a positive way [P_METRO].

A specific model

A *Backward Stepwise regression* procedure is used to derive a *specific model*. The results for the model run excluding the outlier FERs are provided in Table 5, with 18 variables being included in the model. The *specific model* produces an adjusted R^2=0.79 with many more variables (13) being significant compared with the general model results discussed above.

Six variables are significant having a *positive* impact enhancing endogenous employment performance driving-up employment growth in regional FERs over the decade 2006-2016 to a level beyond that attributed to national and industry structure trends. Those explanatory variables that represent factors and processes endogenous to a region and are positive in their influence relate to:

- change in the level of regional incomes [L_INC_CH];

- initially a low level of unemployment [UNEMPL_06];

- the rate of population change [L_POP_CH];

- the change in the Location Quotient for employment in Financial and Insurance industries [LQ_FIN_CH];

- the initial Location Quotient for employment in Professional, Scientific and Technical Services industries [LQ_PRO_06]; and

- the level of volunteering [VOLUNTEER_16].

Table 5: Specific model results (outlier FERs excluded)

Residuals:

Min	1Q	Median	3Q	Max
-2344.96	-549.21	59.47	560.52	2248.02

Coefficients:

Variables	Estimate	Std. Error	*t* value	Pr(>|*t*|)	
(Intercept)	19307.83	5000.62	3.861	0.000226	***
Sci	-85.22	28.33	-3.008	0.003502	**
L_inc_06	1334.30	668.23	1.997	0.049207	*
L_inc_ch	3688.03	1492.18	2.472	0.015548	*
Unemp_06	202.71	73.20	2.769	0.006965	**
Unemp_ch	-86.23	38.77	-2.224	0.028929	*
L_pop_06	-4868.10	360.54	-13.502	< 2e-16	***
L_pop_ch	23757.78	2755.98	8.620	4.47e-13	***
Lq_man_06	-678.11	327.11	-2.073	0.041350	*
Lq_man_ch	-861.00	507.41	-1.697	0.093564	
Lq_inf_06	1500.00	853.77	1.757	0.082711	
Lq_fin_ch	8494.83	2119.94	4.007	0.000136	***
Lq_pro_06	5563.91	1143.29	4.867	5.51e-06	***
Postgrad_06	-21822.93	16802.93	-1.299	0.197712	
Bachelor_06	-29836.97	9130.98	-3.268	0.001592	**
Bachelor_ch	-34069.70	12692.19	-2.684	0.008811	**
Techquals_06	-9759.23	3979.05	-2.453	0.016329	*
Volunteer_16	-21379.76	5616.17	3.807	0.000272	***
D_remote	1253.49	705.89	1.776	0.079528	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 1023 on 81 degrees of freedom
Multiple R-squared: 0.8337, *Adjusted R-squared:* 0.7968
F-statistic: 22.56 on 18 and 81 *DF*, *p-value:* < 2.2e-16

Source: The authors

A further seven variables are significant but have a *negative* effect on the endogenous employment performance of regional FERs over the decade 2006-2016. They represent factors and processes endogenous to a region that are detrimental holding back growth in regional employment. Those significant variables with a negative effect are:

- a region's Structural Change Index [SC]);

- the rate of growth in regional unemployment [UNEMP_CH]

- the initial size of population [L_POP_06];

- the initial Location Quotient for employment in Manufacturing industries [LQ_MAN_06];

- the initial incidence of persons in the labour force with a Bachelor Degree [BACHELOR_06];

- change in the incidence of persons in the labour force with a Bachelor Degree [BACHELOR_CH]; and

- the initial incidence of persons in the labour force with Technical Qualifications [TECHQUALS_06].

When the *backward stepwise regression model* to derive a *specific model* was run *including the outlier FERs* there is a much lower level of explanation, with an adjusted R^2=0.45. The number of variables that the procedure includes in the model is considerable reduced to only nine variables, eight of which are significant - five in a *positive* way and three in a *negative* way. This is fewer significant variables that the 14 significant variables in the model run excluding the outlier FERs.

In comparison with the model run excluding the outlier FERs, the model including the outlier FERs results in the following:

- variables that are no longer significant are: SCI; UNEMP_06 and UNEMP_CH; LQ_MAN_06; TECHQUALS_06; BACHELOR_CH; and VOLUNTEER_06;

- variables that remain significant are: LQ_POP_06 negative; L_POP_CH positive; LQ_FIN_06 positive; LQ_PRO_06; BACHELOR _06 negative; P_METRO positive; and

- the variable that becomes positive is: POSTGRAD_CH.

IMPLICATIONS OF FINDINGS

What implications for regional development policy in Australia might be drawn from the findings of the analyses undertaken in this paper modelling spatial variation in endogenous employment performance of FERs across regional Australia over the decade 2006-2016? What are the factors that might be significant in helping to explain that variation in regional performance?

Regarding the spatial pattern of endogenous employment performance of FERs across regional Australia, the following conclusions may be drawn:

1. Overwhelmingly the endogenous regional employment performance of FERs across regional Australia over the decade 2006-2016 - a period spanning initially the GFC and the end of the mining/resources boom and the subsequent recovery with a continuation nationally of the long period of economic growth - has been *negative*. That fits the popular rhetoric that regional Australia is suffering compared with the metropolitan cities.

2. Just a handful of FERs record a *positive* performance. And that limited incidence of positive performance is not associated with regions that have similar attributes. Rather, the positive performance is found in a wide variety of regions, including: some FERs with large urban population growth areas adjoining a metropolitan area; some remote mining regions; and some remote indigenous regions which are a special case being recipients of a significant infusion of government-sponsored employment-generation grants.

3. The incidence of *negative performance* is spread widely across regional FERs that are: both large and small in population size; located across coastal areas; located across the inland wheat-sheep belt; and are in remote locations.

Thus, there is no stereotype of a region that is a strong or poor performer on the measure of endogenous employment performance used as the dependent variable in the modelling undertaken and reported in this paper.

The spatial econometric modelling undertaken to identify factors that might be significant in potentially explaining the considerable spatial variation evident in the endogenous employment performance of FERs across regional Australia might be regarded as perhaps producing some

unexpected and certainly inconclusive results. It is difficult to draw definitive conclusions as to what factors and processes endogenous to a regional FERs might be having an enhancing effect or what might be detrimental holding back regional employment growth and even resulting in decline.

However, from the modelling it is possible to suggest the following:

1. Regional *industry structure* is important, with the Structural Change Index appearing to have a significant but negative effect. The degree of industrial specialisation/diversification seems not to be significant in explaining endogenous regional employment performance in either a positive or a negative way.

2. Regarding *population*, if anything size *per se* seems to have a significant *negative* effect, which is, perhaps, surprising. Thus, a large population does not necessarily generate regional employment growth over and beyond that attributable to national and industry mix effects, while the *rate of population growth* does seem to be a significant *positive* factor enhancing employment growth.

3. *Regional income* and *change in regional income* have a *positive* impact on performance.

4. The *level of regional unemployment* can be *significant*, and an *increase in unemployment* has a *negative* impact.

5. Using Location Quotients for regional employment in industry sectors in a FER, it is evident that a high concentration of *employment in manufacturing* has a *negative* effect, while the concentration of *employment in producer services industries* - and especially in finance and insurance and in *professional, scientific and technical services* - is *advantageous* enhancing endogenous regional employment performance.

6. The findings regarding the impact of *human capital* measures is somewhat counter-intuitive, with the modelling showing that the *incidence of people in the workforce with a bachelors* or *a technical qualification* in fact seems to have a *negative* effect for endogenous regional employment performance.

7. Depending on the model used, the incidence of *volunteering* - a surrogate for social capital - can be have either a *positive* or a *negative*.

8. It seems that the *locational attribute* of a FER in regional Australia does not necessarily have a significant *positive* or *negative* impact. Thus, it is not the case that a remote location will have a significant impact one way or the other. Nor does it seem to matter whether a FER is classified as being urban. And nor does it matter if it is located inland or on the coast. But it does seem that being *adjacent to a metropolitan area* has a *positive* effect enhancing employment growth.

CONCLUSION

It is evident that neither a *positive* nor a *negative* endogenous employment performance for FERs across regional Australia is associate with a regional stereotype. The popular rhetoric about regions does is not necessarily match results of the modelling reported in this paper.

But it is true that a *negative* endogenous regional employment performance is widespread - even pervasive - across Australia's regions, and that included FERs across all categories of the national settlement system.

It is not particularly clear as to what factors may or may not be significant in enhancing endogenous regional employment or for being detrimental holding back employment growth

or even resulting in decline. The modelling comes up with results that are mixed, sometimes being counter intuitive questioning established regional development rhetoric, and at other times reinforcing established rhetoric. Being remote, being urban, or being located on the coast or inland seems not to matter much, there being FERs in all those situations that are positive and negative performers. But, being adjacent to a big capital city metropolitan area might be a *positive* thing.

It is not possible to be definitive about what attributes of FERs across regional Australia are clearly positive or negative drivers of endogenous regional employment performance, except to say that an increase in population size rather than size itself might have a significant positive influence, as might the level of unemployment. Some aspects of industry structure certainly seem to be important influences, with the concentration of employment in manufacturing being negative, while concentration of employment in some of the producer services is a positive factor. Population size seems not to matter one way or the other. And, if anything, human capital is not significant and might have a negative effect, which is an important finding given the heavy emphasis that policy has been placing in expanding the tertiary education system under the proposition that investment in human capital enhance regional growth.

All of this means that framing policy for economic development across regional Australia will not likely be beneficial if strategy embracing regional stereotypes is employed, nor if the approach focuses on picking industry winners. Rather, assisting the economic development and employment performance of a FER in regional Australia might best be approached through strategy that is explicitly and specifically designed and adopted to take account of the particularities of each region, including its economic functions and employment structure, export performance, size and locational attributes. That is, a bottom-up approach.

Certainly using an endogenous regional employment measure which identifies whether or not a region has positive or negative attributes that enhance employment growth or are detrimental for it is an important thing to do, as focusing on aggregate employment change will hide that endogenous character of a region which needs to be understood if regional economic development enhancing interventions are to be formulated and implemented and for them to be effective.

Acknowledgement

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Working to Grow Together: Horizontal Collaboration for Horticulture Production in Queensland

Delwar Akbar, Azad Rahman, John Rolfe, Susan Kinnear, Peggy Schrobback, Surya Bhattarai

Central Queensland University

Email: d.akbar@cqu.edu.au

ABSTRACT

The horticulture sector in Queensland is highly diverse, producing tropical fruits, many varieties of vegetables, cucurbits and nuts. There is potential to expand horticulture production with more land and water becoming available. However, domestic demand for many horticulture products is currently saturated in peak seasons, leading to lower farmgate prices. Therefore, exporting high value horticulture produce (HVHP) to Asian destinations may offer market diversification for future growth of horticulture industries in Queensland. Currently staggering of supply of horticultural products is achieved as crops are not simultaneously grown across wide geographic regions due to the variations in weather, water availability and soil condition. For instance, farmers harvest mangoes in the far-north Queensland during August-October while Southeast Queensland's farmers harvest their mangoes between January and April each year. This study aimed to examine the potential for greater cross-regional collaboration between farmers (i.e., horizontal collaboration) to ensure a continuous and consistent supply chain of large volume of horticulture products over six- to eight-month annual window. This study particularly focused on a case study of mango production using a qualitative approach consisting of a stakeholder workshop supported by literature review and face to face scoping interviews. While some discrete collaborations among mango farmers are occurring in some regions of Queensland, a cross-regional supply chain collaboration supported by both the industry and other supply chain stakeholders would improve returns to mango producers in the short to medium term.

Keywords: Export, mango, collaboration mechanisms, Asian markets, Australia.

1. INTRODUCTION

Queensland landmass largely represent tropical and subtropical regions, featuring grassland and desert in the west, mountains and productive coastal areas to the east. Rainfall is highly variable across Queensland, with long term annual average rainfall being 628 mm (DES, 2019). These physiographic and climatic variabilities create diversity in Queensland's agricultural sector. Queensland farmers produce beef, horticulture, livestock, dairy, broadacre crop, sugar cane and aquaculture products, contributing about $16.9 billion annually to the state's economy (RDADDSW, 2016). Currently, about 135,000 hectares of land are used for perennial and annual horticulture production, with about 34.5 million hectares of land potentially available for increased production (DAF 2018). By production tonnage, banana is by far the state's major

horticultural product, however the highest export volume occurs in mandarins, mangoes, macadamias and melons (Hort Innovation, 2019).

While the bulk of horticulture production goes to domestic markets, Queensland exports more than $300 million worth of fruits and vegetables to Asian markets annually (Goodman, 2019). There are opportunities for potential growth of Queensland's horticulture sector by developing better export supply chains, particularly for the high value perishable commodities (AAC, 2019; RDADDSW, 2016; Sun, 2016; DAFF, 2013, DAFF, 2014). Trade Investment Queensland (TIQ) has predicted that the export volume of Queensland agriculture products could be doubled rapidly through developing supply chain collaboration, increasing productivity, reducing business risk, offsetting seasonal risks, product innovation, new market discovery and providing tax advantages for farmers and exporters (TIQ, 2019). However, developing export markets requires consistent supply, which can be a major constraint in developing export market opportunities (Ash, 2017; Sun, 2016). This requires horizontal collaboration among the farmers across local and regional levels. Several researchers have explored the challenges of an export oriented agricultural supply chain, highlighting a range of barriers associated with production, processing, trade, transport and logistics (Ash et al 2017; Wegner, 2017; McCarthy, 2015). However, very few studies have addressed the challenges of horizontal coordination in supply chains, which is necessary to maintain consistent supply.

This study examines the horizontal collaboration issues and mechanisms that can foster exporting horticulture produces from Queensland to Asian or any other international markets. The paper provides a conceptual framework, describes the methodology and methods used for evaluation of the horizontal collaboration model, presents the findings, critically analyse the results and provides conclusions.

2. AGRICULTURAL SUPPLY CHAIN COLLABORATION: CONCEPTUAL FRAMEWORK

Agricultural supply chain collaboration (ASCC) refers to a joint initiative of two or more discreet organisations involves in the supply chain, that work together in order to achieve shared objectives or goals through joint planning (Armayah et al., 2019, Cao and Zhang, 2011). Agricultural supply chain collaboration can be either strategic or opportunistic (Figure 1), depending on the collaboration culture as well as the success at each level of collaboration.
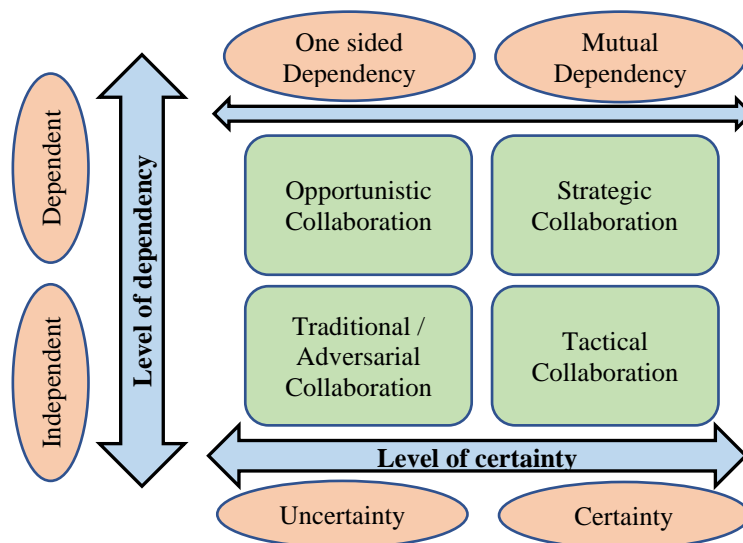

Figure 1: Purpose of supply chain collaboration (Source: Adopted from Cousins, 2002)

In the opportunistic case, the collaborators attempt to achieve short run outcomes in terms of return on investment but are unlikely to share risks and uncertainties. By comparison, strategic collaboration is built upon mutual understanding and trust developed over time, where the focus is to gain long term returns. Sharing resources and information are common actions in strategic collaboration. This model leads to a better governance approach for the supply chain, but usually takes time to establish. In addition, a framework that support both horizontal and vertical collaboration is necessary for developing a sustainable ASCC (Matopoulos et al., 2007, Dania et al., 2016). Figure 2 provides a conceptual framework of agriculture supply chain collaboration, incorporating both vertical and horizontal collaboration.

Horizontal collaboration amongst producers could be crucial to supply the right amount of produce at the right time, in a scenario not otherwise possible for individual growers. Horizontal collaboration includes growers and growers' associations who may be involved collectively in a supply chain (Figure 2). Vertical collaboration engages growers, farm input service providers, processors, wholesalers, retailers, exporters and consumers who are directly involved with the supply chain (Figure 2).
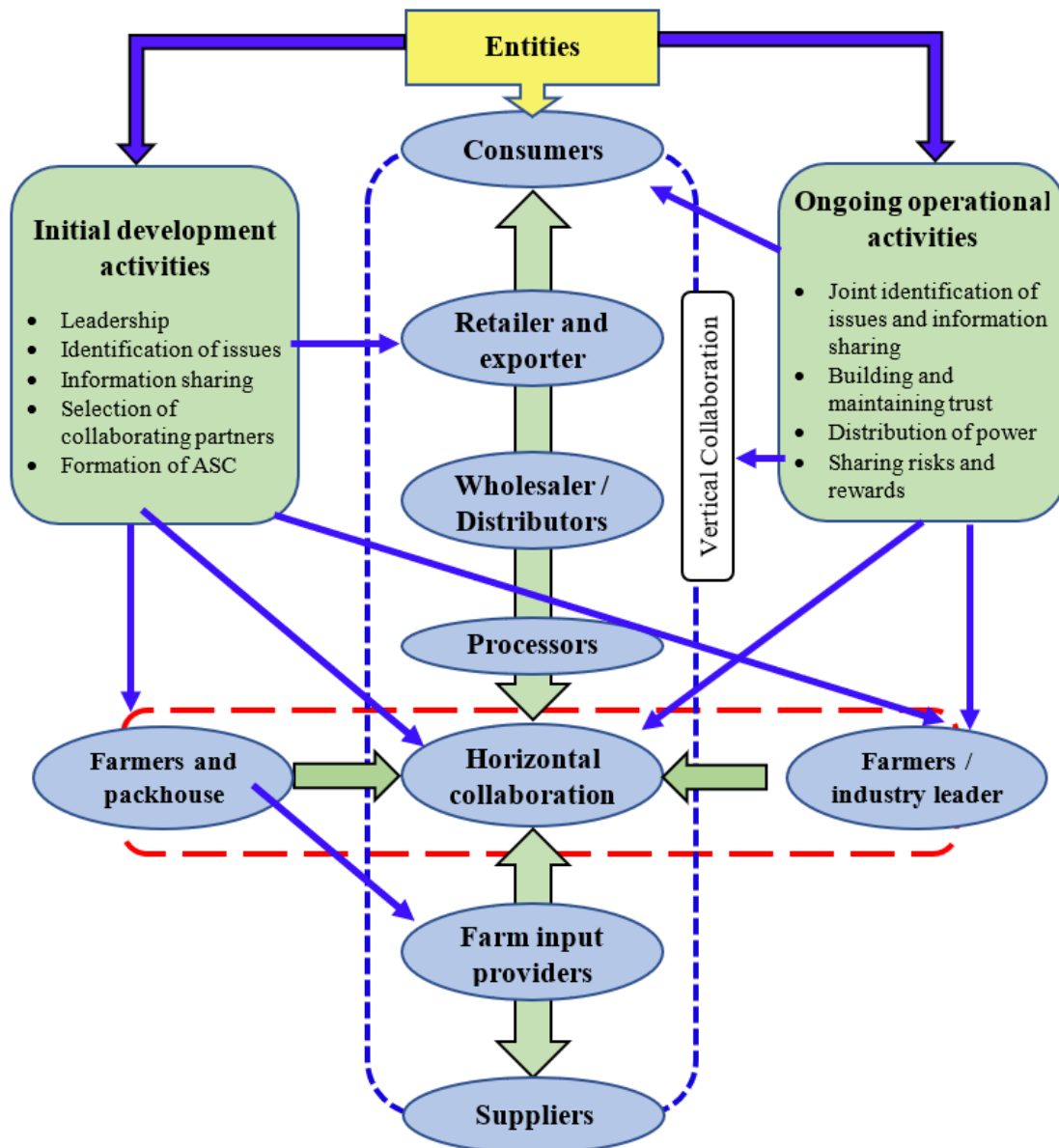

Figure 2: Conceptual framework of agricultural supply chain collaboration
(Source: Based on Barratt, 2004, Matopoulos et al., 2007, Liao et al., 2017)

The next section of this study describes how this conceptual framework was used to develop and explore prospective agricultural supply chain collaboration model for a specific horticultural crop (mango) in Queensland.

3. METHODS AND MATERIALS

This research involved a qualitative approach, comprising several steps:

- a literature review on theory and practice of agricultural supply chain collaboration,

- scoping interviews with farmers, industry representatives and other relevant stakeholders,

- an initial pilot test of workshop tasks and

- a stakeholder workshop to test an agricultural supply chain collaboration model for selected horticulture products in Queensland.

The conceptual framework for ASCC model (Figure 2) was used as the basis for developing and testing the workshop tools.

The workshop process was designed to analyse several key issues in forming both horizontal and vertical collaboration among the parties involved in the supply chains of three selected horticulture products of Queensland. However, this paper only reported the tasks and findings related to the case of mango. To ensure the involvement of a cross-section of stakeholders, the research team invited about 50 potential participants for the workshop.

There were three segments of the workshop, commencing with expert presentations on some topics relevant to the workshop theme; and then two data collection exercises directly involving the participants with individual and group tasks. In the third stage of the workshop, the research team split participants into three groups by horticultural product depending on their expertise and interest. The participants were asked to identify the most suitable links among the entities to indicate their preference on collaboration models for the sector. The same task was repeated individually and in group form. However, this paper only reports the horizontal collaboration in case of exporting mangoes from Queensland to Asian markets.

During the group task, participants were encouraged to contribute to open discussion and develop a combined ASCC model for one of the three chosen commodities. Participants also took part in a discussion on horizontal and vertical collaboration could be coordinated. The research team subsequently undertook a narrative and thematic analysis to evaluate the qualitative data collected during the workshop.

4. FINDINGS AND ANALYSIS

4.1 Participants

The research team invited 50 potential participants for a six-hour workshop. However, only 28 persons attended face to face on site and one through a virtual platform (Figure 3). Most of the participants represented farmers groups, state government officials and researchers.
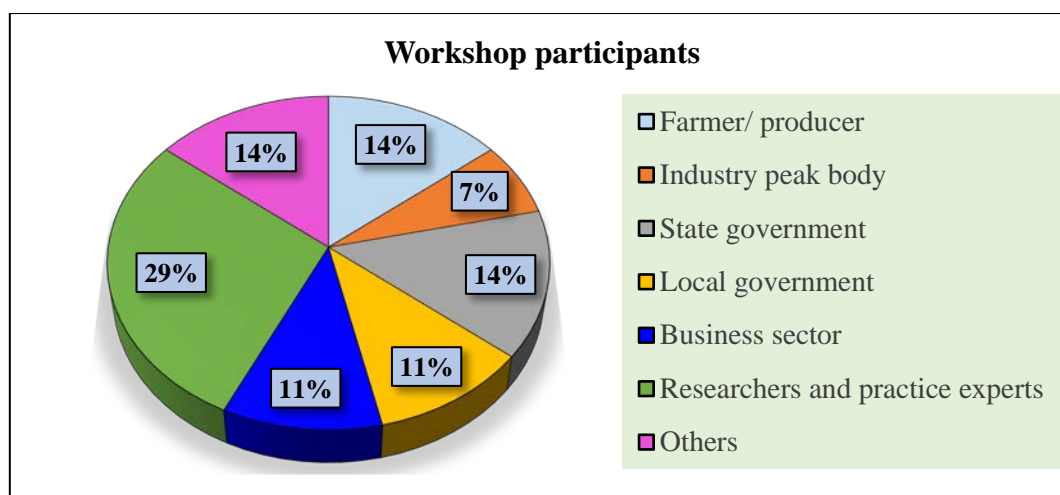
Workshop participants

Legend
☐ Farmer/ producer
☐ Industry peak body
☐ State government
☐ Local government
■ Business sector
■ Researchers and practice experts
☐ Others

Pie chart values: 14%, 7%, 14%, 11%, 11%, 29%, 14%

Figure 3: Percentage of workshop participants

4.2 Expert presentation

The research team invited four experts to deliver short presentations on the policies, opportunities and mechanism of agricultural supply chain collaboration for exporting high value perishable agricultural commodities (HVPACs) to the Asian markets. This discussion emphasized industry-led research collaborations with a strategic focus to increase wealth and employment opportunities and to improve production and supply chain efficiencies through ASCC. It was noted that there is significant demand for Australian horticulture products in Asian markets, but that in any given year, the entire horticultural production of Australia could only meet the demand of Tokyo (not Japan), and supply fluctuates substantially. So, a challenge for Australia is to develop horizontal collaboration models to coordinate supply into targeted markets. The experts recommended improving horizontal collaboration to improve volume and consistency of supply and flexible collaboration/collaboratives in supply chain design.

4.3 Individual tasks and the model

In the second segment of the workshop all the participants were provided with a questionnaire to complete. They were asked to draw the linkages among key actors in the supply chain to indicate their preferred form of a collaboration model. The participant responses indicated several critical issues in the production stage, with water availability, cost of production and quality of products identified as the three most critical issues across the regions for production of selected horticultural crops. Transportation and technologies were also identified as major issues. Interestingly, none of the participants thought that direct government support and foreign investment were very important for the future growth of the horticulture sector. However, on average 48% of respondents believed that domestic investment is vital for this sector, and about 75% of respondents rated market access as the most critical issue.

The outcome of the Mango-specific data collection exercise is illustrated in Figure 4, which indicates the preference of two major groups of participants. Most participants identified producers, selling agents, exporters and retailers as the key actors to reach international consumers. About 41% of respondents indicated that selling agents would be vital to draw a linkage among the producers and exporter and/or retailer (Figure 4a). They also indicated that the selling agent could act as an exporter to supply the product directly to the consumers via retailers. However, 27% of participants acknowledged a similar relationship but unlike the first group they considered that the selling agent is not an essential actor in an export supply chain (Figure 4b). Both groups recognized the importance of genetic companies and technology providers in the ASCC.

One interesting outcome of this exercise was the addition of packhouses into the model which was not initially included by the research team. The research team considered that the processors would be more appropriate actor for the export supply chain, however, the participants thought differently. Most participants indicated that packhouse facility should be linked with the producers and act as a single actor within the horizontal collaboration. This exercise also reflected the preference of the participants to avoid wholesalers and distributors in the supply chain. The results did not indicate any relationship between the producers and government and/or industry body.
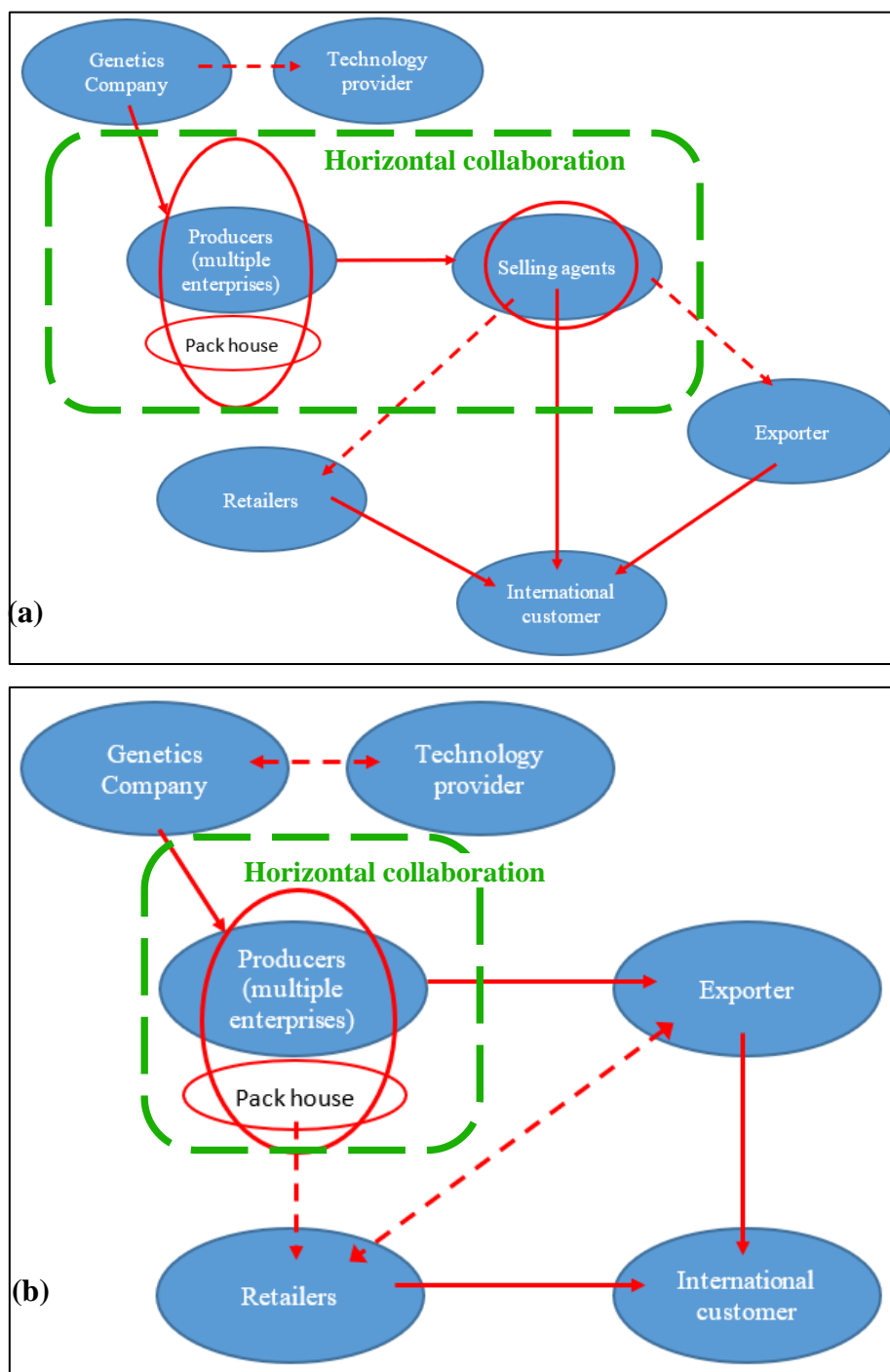

Figure 4: ASCC for Mango a) response of 42% participants, b) response of other 27% participants (Note: The solid lines in the figure indicate a strong relationship while the dotted line indicates a moderate relationship)

4.4 Group discussion and the proposed models

In the final segment of the workshop, the research team formed three separate groups focused on individual crops. Each group was tasked to develop a prospective agricultural supply chain collaboration model for one of the selected horticultural products. This paper only reports the group discussion on the structure and mechanism of ASCC for the mango industry in Queensland. The model presented in Figure 5 was developed by the agreement of all or most of the participants within this group.

In developing this model, the discussion was based on an authentic example of collaboration that is currently used to export HVPACs to the Asian markets. The group provided examples such as Manbulloo mangoes, who are currently exporting mangoes to the Asian markets. However, this single company-led vertical supply chain model may not necessarily be applicable in the context of small and medium scale mango growers in Queensland. The group members suggested horizontal collaboration among the small and medium-scale farmers may be more appropriate (Figure 5), together with a strong partnership or collaboration with the fruit grading and/or protocol processors (Figure 5). The mango producers in this group particularly wanted to bypass the wholesaler in an attempt to avoid unnecessary costs or sharing of profits.

The group emphasized that a medium-scale grower can afford to operate grading and processing infrastructure, and this can be offered to smaller growers on fee basis. As such, the growers can work together and communicate with the exporter or export fruit processors (e.g. where heat treatment or radiation treatment is applied). That will allow the producers to avoid unnecessary commission costs that are commonly paid to the wholesalers. The group suggested that leadership is required to initiate this type of collaboration among smaller mango growers.

All the participants agreed that the producers should initiate any supply chain collaboration. However, they added that producers should also have direct access to the exporter and not through other 'middlemen' (Box 1). It was also argued that it could be a multiple leader-led collaboration, so will not necessarily rely on an individual to initiate the collaboration (Box 1).

Box 1: Key comments

From a researcher: "*So either it goes on the corporate systems or any corporate governance systems whatever the system is, but we really need to link them (producers and processors), so the processor can directly access to the exporters*".

From a government officer: "*So I think the question is not who's going to lead it because at different points everyone has a different leadership role. It's not one leader. It's multiple leaders. But when do you rise to be the leader at this point?*"

The participants agreed that collaboration needs to be developed amongst like-minded mango growers even if they are from different regions. Emphasis was also given on the transparency of the collaboration model in terms of pricing, information sharing and risk-sharing. Participants also agreed that achieving better prices for lower graded mangoes should be a key feature of any supply chain development work. Furthermore, during the discussion on the supply chain mechanism, participants noted that it is important to collect reliable data and analyse those data to create better forecasting models for demand, production and weather events.
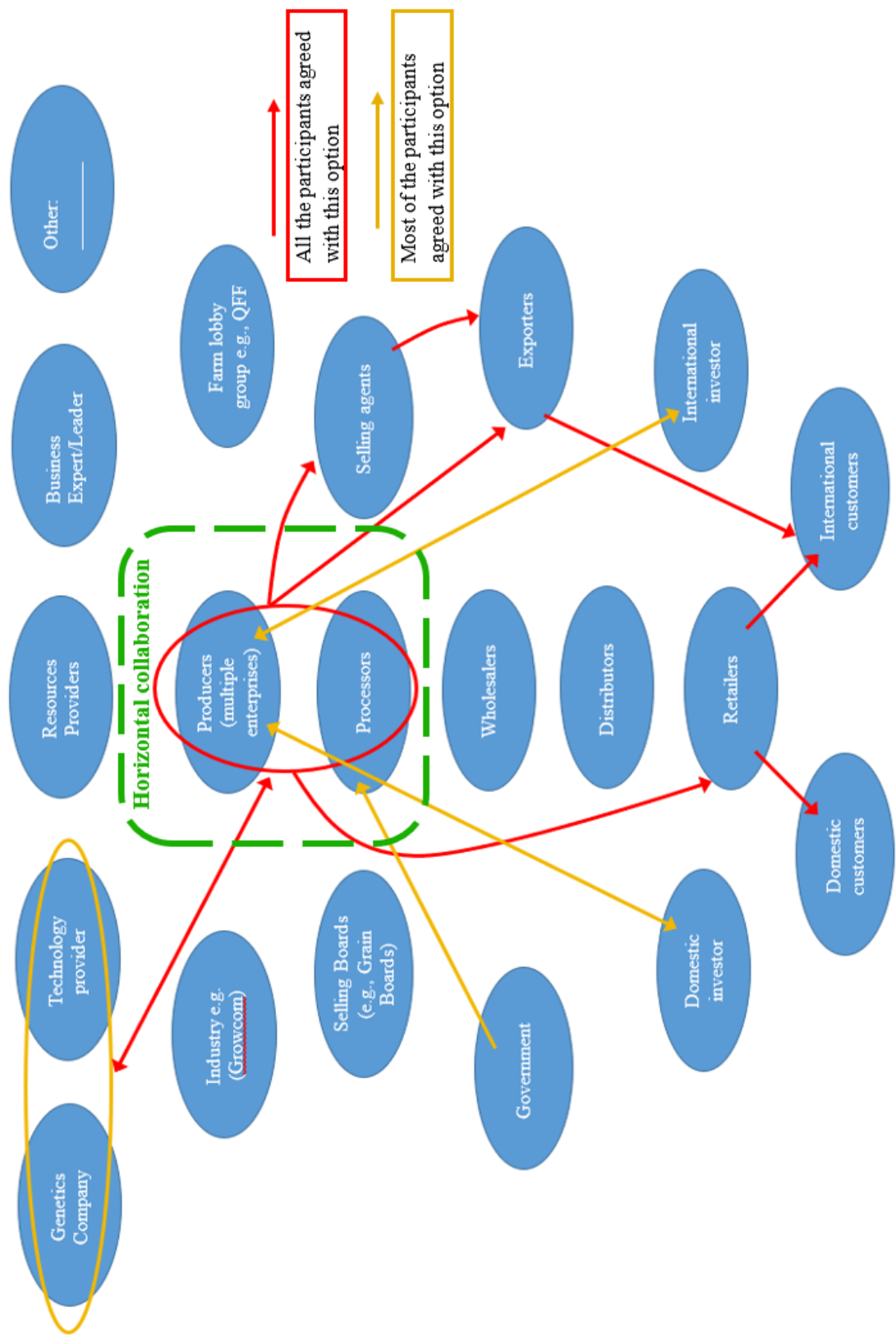
Figure 5: Prospective or existing linkages amongst actors involved in a collaborative supply chain for mango industry, as identified during the workshop activity

4.5 Discussion on issues and mechanisms of horizontal collaboration

One of the purposes of the stakeholders' workshop was to identify the issues and mechanisms of agricultural supply chain collaboration (ASCC) for the avocado, lychee and mango industries in Queensland. During a series of group tasks, the participants provided their in-depth understanding and developed a consensus on the issues and mechanisms. Key findings from discussion groups regarding issues in ASCC are presented in Table 1. This table summarise the issues of ASSC into a few categories: quality, resources, collaboration, market access, infrastructure, risk and support.

Table 1: Stakeholders' perception of key issues in agricultural supply chain

Key issues	Specific issues
Quality of product	Appearance (Colour & size)
	Taste
	Combination of appearance and taste
	Consistent yield
	Shelf life
	Disease freeness
	Quality control
Resources	Water
	Information & training
	Labour (sourcing)
Collaboration	Selecting partner
	Leadership
	Management role
Market Access	Export readiness
	Domestic vs International
	Market exposure / Premium market
	Market power
Infrastructure	Facility sharing
	Fruit treatment facility
Risk	Investment
	Price
	Cost of production
	Market saturation
	Extreme weather
	Disruption in supply chain
	Conflict management
Support	Long term business plan
	Financial stability

Most participants identified product quality as a major issue. Quality can be defined based on its physical appearance, taste, shelf life and disease status. Consistent yield and quality control systems are two relevant issues, which can affect product quality. Lack of resources is also a major issue in ASCC. Insufficient information and limited effort in research and development are common phenomena in all three industries. Currently, Australia is exporting mangoes in small volumes, but there is significant international competition in the premium markets.

All participants of the workshop recognised that there is currently limited collaboration among farmers and the other actors involved in the exports of perishable commodities into the Asian markets. In horizontal collaboration, leadership and the selection of partners are the starting points to initiate collaboration. Market access was also identified as a major limitation. One of

the key questions participants raised was whether the selected horticultural industries have all the elements required to achieve export readiness. Price fluctuations and disruptions in the supply chain were frequently mentioned during the workshop. Other limitations identified were lack of long-term business plans and limited financial stability of the farms.

The framework of collaboration presented in figure 5 (i.e., collaboration structure) was developed based on the responses of participants during the individual and group tasks. Apart from the structure of the collaboration, several mechanisms for developing and maintaining collaboration have been drawn from the group discussion. Broadly they are identifying and reaching consensus on collaborative tasks, coordination, marketing and governance and adhering to policy and planning. All discussed mechanisms for horizontal collaboration are listed in Table 2. These mechanisms indicate the pathways for developing and maintaining collaboration. Firstly, at least a few leaders or actors need to understand the structure of the collaboration, which includes the identification of potential collaborator at all levels of the supply chains. The most important actors are producers, processors, genetics companies and technology providers. Cross-regional collaboration was suggested as options to achieve more coordinated supply.

Table 2: Functions and mechanisms to achieve horizontal collaboration for ASCC models

Key function	Specific mechanism
Collaborative initiations	Initiator to lead and partner selection
	Framework for collaboration
	Cross regional collaboration
Collaborative activities	Communication among the collaborators
	Information sharing: production inputs and standard
	Information sharing: market access and demand
	Price setting
	Risk sharing
	Profit sharing among growers
Coordination	Business network among growers
	Role of industry (or government) in horizontal collaboration
Governance	Government supported R&D program
	Equity in power distribution
	Joint venture
	Corporate governance
Marketing	Clean, green and fresh slogan
	Global brand for Australian produce
	Regional brand
	Trademark property rights and brand security
	Traceability and quality control
Others	Lesson learned from the existing models of other horticulture industry
	Commercial behaviour of producers

Several collaborative activities were identified through the thematic analysis. In horizontal collaboration, sharing is identified as the main mechanism. This includes information sharing,

resource sharing, risk sharing and profit sharing. In vertical collaboration, some other activities were discussed, and one common structure suggested by the participants of all three groups was a joint venture. Getting support from government and industry was also categorised as a collaborative task. Negotiation with the potential importer for a reasonable product and price contract is also a part of the collaborative activities in vertical supply chain collaboration.

Coordination and good governance are two essential mechanisms to deliver a successful collaboration. The role of the industry groups in devising or developing coordination and a governance framework is essential for both horizontal and vertical collaboration. Equity in power distribution and transparency are very important for the sustainability of the collaboration. The workshop participants also placed emphasis on government-supported R&D programs for both collaboration and supply chain enabling infrastructure. In vertical collaboration, development and adherence to policies and regulations are one of the key governance mechanisms. Policies and regulation could relate to agricultural production, biosecurity and/or exports. Some drivers that can affect collaboration mechanisms either positively or negatively were discussed in the workshop (Table 3).

Table 3: Drivers affecting the mechanism of ASCC

Collaboration	Drivers
Horizontal	Government and industry: engagement and incentive
	Counter seasonal advantages
	Foreign direct investment
	Attract domestic investors

The engagement of government and industry could be important in network development, training, developing enabling infrastructure and providing incentives. Investment from domestic and international market players could inject cash flow and trigger collaboration in each of these selected industries.

5. CONCLUSION AND RECOMMENDATIONS

This study identified three categories of issues. The first category includes production inputs, their cost, quality and water supply required to grow the commodities. The second category is related to use of technologies in transport and technology needs including logistics, advanced agricultural technology and innovation in genetics and value-added products. The third category is related to marketing, including market access to certain medium and high-income Asian countries, brand development and recognition, traceability and market discovery. This study identified a number of possible mechanisms for horizontal supply chain collaboration for exporting perishable commodities from Queensland. This study highlights the role of an individual horticultural industry association (such as Growcom) or a processor is crucial for horizontal collaboration among the farmers.

The stakeholders identified that mango supply chains for international markets are reasonably established in Queensland. However, horizontal collaboration is needed between the small and medium scale farmers to ensure consistent supply of product into the international markets. Value-added production facilities are also suggested to process any excess production during peak harvest period (November-January) across Queensland. The mango industry already employs several supply chains to export to international markets, however, further strategic

collaboration amongst the genetic industry, primary producers, processors and exporters is suggested for the longer-term market gains. This could represent both process and management-oriented collaboration.

The workshop participants identified that horizontal collaboration among farmers may plan an integral and important role in agricultural supply chain collaboration (ASCC) to increase the export volume of the selected fruits from QLD. Participating stakeholders presented various views about the governance mechanisms, however, majority suggested that government (state and/federal) should facilitate the industry bodies in the process of horizontal collaboration, particularly for product and contract standards, market access, and conflict resolutions. The workshop proposed models for three fruit industries of QLD (i.e., avocado, lychee and mango), and we suggest that these models may well be relevant for other tropical fruit industries of Queensland.

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Growing Mackay Region's Professional Capital; Sustainability Through Collaboration – A Case Study: Engage Mentor Program

Maree Franettovich and Robyn Collins

Central Queensland University

Email: m.franettovich@cqu.edu.au

ABSTRACT

The Engage Mentor Program is a case study in regional professional capacity building, undertaken by CQUniversity Mackay School of Business and Law, in collaboration with a major industry partner and the region's business community. This Program aims to build regional professional capital and retain local business students. The Engage Mentor Program connects business students with the region's business professionals in a dedicated Mentee-Mentor relationship. Mentees also participate in tailored professional development focussing on employability skills, industry knowledge, and workforce transition. Regional career opportunities are highlighted to encourage students to make a deliberate choice to stay. The design capitalised on local assets: an Australia wide University, established collaborative relationships and a shared commitment to developing professional capital to meet regional workforce needs. Outcomes to date indicate the Engage Mentor Program is an effective model for growing professional capital. The challenge is establishing a sustainable collaborative model readily transferrable to other regions.

INTRODUCTION

Regional sustainability requires collaborative communities of professional skills to support and develop future industries and to build regional capacity. This case study describes an initiative in regional, professional capacity building – the Engage Mentor Program. This Program was a collaboration between the School of Business and Law, CQUniversity Mackay, as the university-in-place, industry partner sponsor, Rio Tinto Hail Creek Mine, now Glencore, and the Mackay region's business community. An opportunity was realised, to grow the Mackay region's professional capital through a collaborative approach, building upon existing relationships between these parties.

The Engage Mentor Program positively contributes to the region's business vitality by building professional capital and fostering an environment for retention of locally educated business students while growing mutually beneficial business relationships.

This Case Study describes the opportunity met by the Engage Mentor Program as a grassroots disruption and collaborative innovation. The Engaged Collaboration Model underpinning the initiative's approach is defined. Details of the Program's format, practice and implementation, learnings and challenges are stated. The future of the Program, including the sustainability and delivery mode as well as the potential transferability of the Engage Mentor Program approach

to grow capacity in other regions is explored.

BACKGROUND

CQUniversity's School of Business and Law (SBL) is a national, multi-campus Business School. The School has a number of goals and one is to empower staff, community, business and industry to interact and build partnerships that will provide mutually beneficial outcomes that ultimately support the development of sustainable communities (Professor Lee Di Milia, Dean School of Business and Law, 2017).   In today's competitive employment market, business skills are fundamental to the success of all industries. Consequently, formalised business skills are in high demand (Department of Employment, Skills, Small and Family Business, 2019; Ranosa, 2019).

The role of higher education institutions as place-based leaders, and in particular, the impact of this role in regional communities, is subject to increasing interest (Hambleton, 2018; Allison & Eversole, 2008). CQUniversity is the university-in-place in the Mackay region, and the School of Business and Law, Mackay has well developed collaborative networks with the local business community, possessing strong, established and mutually beneficial relationships and shared goals of regional capacity building and regional sustainability.   An Engaged Collaboration approach (Appendix A), delivers a *Collaborative Place* within which regional innovation can thrive.

In 2016, the Mackay Region continued to be impacted by the mining bust cycle, (Latimer, 2016; Williamson, as cited in *Daily Mercury*, 2016) with a requirement for increased avenues for the delivery of professional capital into the region's business community. The School of Business and Law, Mackay staff developed the Engage Mentor Program concept as one innovative solution to grow the region's available professional capacity. To implement the Engage Mentor Program, it was important to identify an industry sponsor, which was similarly committed to regional capacity building.   Rio Tinto Hail Creek Mine had a long-standing Memorandum of Understanding with CQUniversity Mackay and a shared regional community footprint across the Mackay, Isaac, and Whitsunday regions. Based on this positive existing relationship, the approach was made to Rio Tinto through the Hail Creek Mine Community Development Fund to support the Engage Mentor Program for two years, with the first year as a pilot plus another year. Rio Tinto, as the selected Industry Sponsor had developed a high level of credibility within the region and a visible reputation as a committed corporate citizen with a strong social licence to operate.

THE OPPORTUNITY

Young Australians, particularly in regional areas, need to be more adequately prepared to succeed in the future of work. This suggests that educational institutions transform their traditional approaches to devise complementary programs to produce work ready graduates (Regional Australia Institute, 2018). The School of Business and Law, Mackay identified an opportunity to provide a complementary professional development program for its students and grow Mackay region's professional capital. This highlights an example of innovation and diversifying the types of experiences offered to students to maximise career readiness (Universities Australia, c2019). The existing positive relationship between the School of Business and Law, Mackay and Rio Tinto, facilitated by its dedicated mechanism for community development (Hail Creek Mine Community Development Fund) enabled the realisation of the Engage Mentor Program. Learners should be able to link their learning

experiences to the real world and have a sense of purpose in their learning (OECD, 2018). The Department of Education (2019) identified that the challenges around access to career advice and information are felt more keenly in regional, rural and remote areas. The Engage Mentor Program was premised on increasing awareness and exposure to regional career opportunities for undergraduate university students and highlighting to the business community the relatively untapped resource of a regional skills base of work-ready, business students right on the doorstep.

A skilled population is better equipped and more agile to respond more effectively to the challenges and opportunities in regions (Department of Education, 2019). In retaining regional professional skills, closer attention needs to be paid to the transition to work. The Regional Australia Institute (2018) indicates that without suitable career pathways, regional students *are simply 'learning to leave'*, as they perceive they will be forced to move away to gain meaningful work in their chosen field. The supply of human capital to meet regional labour demand is the focus of discussion in a number of circles, including government at all levels, enterprise and academic study. While locations in the more remote areas of Australia have varied needs, attraction and retention of the right workers is an ongoing problem, which Haslam McKenzie (2011) reports is costing business time, money and lost opportunity. A recent study (Regional Australia Institute, 2019) confirms that human capital on all measures decreases the further from capital cities.

Students who are studying business, accounting or law, do not necessarily have a common body of knowledge on career options and opportunities. For example, through various interactions with CQUniversity Mackay students, it emerged that a common student perception of career options was 'working with a public accounting firm'. There was little mention of other corporate, government or 'not for profit' employment options even where such entities operated in the locale. It is suggested that public accounting enterprises do tend to be more visible in a regional community and to their credit do engage students directly from University providing a vital transition to work and launching of a potential career pathway. There are however other career pathways and the apparent blinkered students' perceptions of career options was potentially limiting desires to establish a career in a regional area.

The convergence of circumstances and timing were favourable to establishing a program complementary to formal academic studies, where students would be exposed to career path options, and participate in professional development activities focussed on the transition to work. A bespoke Mentor Program commenced targeting CQUniversity School of Business and Law undergraduate students, which would support their transition to the workplace and encouraging them to stay and work in the region. In today's competitive employment market, work ready graduates who are not only technically sound, but also, well-rounded are in high demand. To be future ready, students will need a broad range of skills as well as specialised knowledge with capacities to think across boundaries and "connect the dots" (OECD, 2018). A regional university has a positive impact on skilled supply in a regional area (Charles Sturt University, 2009, as cited in Department of Education, 2019). There is a clear benefit to rural, regional and remote industries from the presence of an educational provider. It helps to attract talent, retain and upskill local populations to meet employer needs.

A number of elements converged to form and advance the Engage Mentor Program. These were

- A University right on our doorstep
- Program Managers as Champions with established professional networks; experience in project management and Program delivery
- Students who want careers in 'hometown'

- Longstanding relationship with, and commitment of, a leading profile Industry Partner as Sponsor with a similar regional footprint (Year 1 and 2)
- Established collaborative relationships with active business partners and networks
- Shared commitment by all actors to collaboratively develop workforce capacity
- A business community committed to regional development

The essence of effective leaders is to empower people in the institution to decide how they can best do their jobs. Empowering people who know their work the best is one way of accomplishing 'work smarter' objectives (Saxena, 2013, as cited in Richardson, Jenkins & Lemoine, 2017). The endorsement of the Dean - School of Business and Law, elevated the profile of the Program, which contributed to the value proposition. The Dean underscored the importance of the Program as an opportunity for the students to learn from successful local business professionals, who are dedicated to enhancing the skills of our region's future employment pool. This sentiment was echoed by Industry Sponsor - Rio Tinto Hail Creek Mine, former General Manager, who extolled the Program's benefits. *"By partnering with CQUni to deliver the Engage Mentor Program we are continuing to build the skills capacity of our region; this in turn benefits not just the resource sector, but also a wide range of other industries"*. This combined backing at top management level was a key contributor to the leverage required to foster the opportunity to enable the Program, and reflects the approach of the Engaged Collaboration Model.

RATIONALE FOR MENTORING

There is considerable research on mentoring, and the interest continues to grow. Levinson's seminal book, *The Seasons' of a Man's Life,* was instrumental in examining the impact of mentoring on men's development (Ragins & Kram, 2007). In 1985, Kram published *Mentoring at Work* which captured and defined the construct of mentoring and established a theoretical foundation for research that propelled mentoring as a key part of the business vernacular. Kram has had a long career researching in this field which also resulted in the publication of *Handbook of Mentoring at Work* 20 years on from her original work. Kram's research has continuously evolved to bring a new lens to mentoring responsive to the dynamics of the organisational context (Chandler, 2011), which over time has become more volatile, uncertain, complex and ambiguous.

The practical application of mentoring in the organisational setting is accepted as well as the appeal of mentoring as a personal, tangible and transformational relationship (Ragins & Kram, 2007). Mentoring exists in many forms within business and industry, and across disciplines (Hansman, 2016; Nimmons, Giny & Rosenthal, 2019; Ghosh, 2012). A range of mentoring programs also are on offer for students within Australian universities, which are focussed on student transition to University, support while undertaking studies, or on career development. Nimmons et al. (2019) highlights the importance of the role of mentoring in student and trainee personal development and professionalism, as these elements are not always an explicit component of the curriculum. Mezirow (2009) and Taylor and Cranton (2012) suggest that mentoring provides the environment and opportunity for students to critically reflect upon their assumptions and grow knowledge as they progress through phases of transformative learning.

The traditional Mentor relationship in business was between an older, more experienced mentor and a younger, less experienced protégé in a career context (Kram, 1985) and the mentor may come from the same organisation, and originally was a one-way learning experience. While definitions of mentoring have evolved and been refined, the distinguishing feature is that it is a developmental relationship in the career context (Ragins & Kram, 2007). Over time, the research identified the benefits that also flow to Mentors. Scholars and practitioners have

embraced the two-way flow of learning and the growth of both parties (Ghosh, 2012; Chandler, 2011; Stewart, 2012). The scope of mentoring relationships too has expanded to now include peer mentoring, group mentoring, and virtual or e-mentoring. The Engage Mentor Program drew on the traditional approach where a senior business professional was the Mentor, and the 'junior' in the relationship is the 'student', with the flexibility for two-way learning. The challenge is to balance the level of formality of the program to still allow for the same quality of mentoring present in naturally emerging relationships that typify informal mentoring (Weinberg & Lankau, 2011). In practice, it is integral to ensure that the core attributes of the mentoring experience are present, while at the same time allow for the flexibility as to the structure of relationships and needs of the organisational environments (Gibson, 2004).

The requirement that Mentors are working business professionals is underscored by Renn, Steinbauer, Taylor and Detwiler (2014). This study (Renn et al., 2014) highlights the importance of business mentors providing and/or being trained in how to provide graduating students with coaching in relation to their career goals and preparation for future careers. College students nearing graduation who were mentored by working business professional for eight months in a formal hybrid university-sponsored mentoring program showed that mentor career support was positively related to student career planning (Renn et al., 2004).

THE ENGAGE MENTOR PROGRAM

The Engage Mentor Program is an example of grassroots disruption and collaborative innovation benefitting from retaining local professional talent (Mentees) and developing existing local professionals (Mentors). This Program highlights regional career opportunities to students so that they may make a deliberate and informed choice to 'learn to stay', to live and work in the Mackay region. The Program design capitalised on local assets: an Australia wide University right on the doorstep, established collaborative relationships with active business partners, and a shared commitment to developing professional capital to meet the region's workforce needs. Regions rely on business for jobs and prosperity. The Engage Mentor Program is an holistic approach to influence linking local and regional labour markets and learning systems connecting the important contributors and getting better outcomes for their residents (Regional Australia Institute, 2019). This Program connected eligible students of the School of Business and Law, Mackay with the region's experienced business professionals in dedicated Mentee-Mentor relationships. Working business mentors provide valuable insights into the job market and careers and potentially career related advice (Renn et al., 2014).

The overarching aim of the Engage Mentor Program is *regional capacity building*, positioning students to establish their careers and become future business leaders who ultimately will remain (or return) to live and work in this region. It is about:

- connecting students with experienced business professionals
- developing students' employability skills and industry knowledge
- focussing on personal growth to enhance career prospects and enable workforce transition
- igniting in students a passion to excel in business; and
- providing opportunity for the region's business professionals to develop regional capacity.

The purpose of the program is not about students securing employment, however there was an intended emphasis on job search intentions and personal employability as part of their career development.

Mentor Programs boast a range of characteristics across disciplines and institutions, including resourcing, with the design and delivery adapted to suit respective needs (Nimmons et al., 2019). Ghosh (2012) emphasises that developmental initiatives such as mentoring need to be attuned to the exclusive needs of contexts and cultures of schools and business organisations (p. 170). Weinberg and Lankau (2011) suggest that formal mentoring programs of at least nine months in length offer efficient support regardless of the varying background of proteges or difference in mentor characteristics. The Engage Mentor Program is a formal hybrid mentoring program; it is timebounded - conducted over 12 months. It is based on a structured model with a 'curriculum', incorporates a formal matching process and has a level of resourcing. In relation to the Engage Mentor Program, the direct support provided by the Industry Sponsor funded some resources (not staffing) and event costs in accordance with the funding agreement. This enabled the Program to operate without the need to compete for internal University funding. The Program Managers provided their expertise as in-kind support, however there was no dedicated administrative resourcing.

The Engage Mentor Program has a prime focus on the Mentees' development (Kram, 2007), however the Mentors may enjoy personal or career benefits from participating in the Program (Weinberg & Lankau, 2011; Carle, 2018; Kram, as cited in Chandler, 2011). Reciprocity is a key attribute of the mentoring relationship as defined by Kram (Gibson, 2004). The personalised relationship was a key pillar of the Engage Mentor Program. A point of difference in the Engage Mentor Program is that the student is an emerging business professional as opposed to a junior professional of the existing business or another business. The Program provides also for an element of group learning and socialisation (Higgins & Kram, 2001) for the Mentees through participation in collective professional development, which is a distinguishing feature of the Program. A senior academic colleague commented (2017) that "*these activities are making the student learning experience more authentic, taking it beyond the classroom and into the community*".

The Program involves recruitment of eligible CQUniversity Mackay students as Mentees, and practising business professionals willing to serve as Mentors. The application process for Mentees is similar to that for professional job roles. Students are required to submit a completed application form, a statement addressing the selection criteria, Curriculum Vitae, and nominate two referees. Recruitment is undertaken during December to January. Selection of the Mentees occurs based on their application and an interview process. Referees also are canvassed to confirm interview outcomes and provide insights on the respective Mentees' development requirements. Following the interview process, the Professional Development Calendar is confirmed, tailored in part to the Mentee cohort specific skill set requirements.

Table 1 Eligibility Criteria for the Engage Mentor Program

Mentees	Mentors
Studying a Higher Education Undergraduate Course in Business; Accounting; Law; Digital Media (Year 2); Professional Communication (Year 2); or a related Course at CQUniversity	Hold a recognised Higher Education qualification e.g. bachelor's degree or above.
Successfully completed a minimum of 4 Units of a Bachelor's degree (preferably 8 Units)	Five or more years professional experience
Grade Point Average of 4 (minimum)	Ability to commit time to a dedicated Mentor - Mentee relationship
18 years of age by 1 March of the Program Year	Ability to attend key Program events
Demonstrated community contribution	
Established organisational and time management skills	

Formal programs also are distinctive in that Mentors are recruited and selected and there is a structured matching process, which is not a component of informal mentoring (Weinberg & Lankau, 2011). Once the Mentee cohort is determined, The Program Managers then undertake the process of matching with a dedicated Mentor. Mentor applicants submit an Expression of Interest, supported by their Curriculum Vitae, and certification of formal qualifications. Mentor expressions of interest are checked for eligibility and credentials verified. The dedicated matching is based on the students' needs, including stated areas for development, and not necessarily established on similar technical skills or discipline area. Students also indicate if they have a preference for a same gender Mentor (there is no undertaking this can be accommodated). To date, the Program Managers' personal knowledge of Mentors facilitated this matching process, without using dedicated software. Following the matching process, the Program's operational arrangements are progressed with a launch event. An important aspect of the launch is the Mentees' presentations outlining their expectations for the Program which runs from April through December.

Mentees attend an induction conducted by the Program Managers where the performance requirements are outlined by the Program Managers and there is an opportunity for them to raise any questions without the presence of Mentors. Mentors had a separate induction provided by the Program Managers. Clear governance arrangements are crucial to program delivery and to defining the roles and responsibilities of all parties, including Mentors, and the balance between challenge and support (Ramani, Gruppen & Kachur, 2006; Business Queensland, 2019). A Handbook was published (Year 2), which is a key reference for Mentors and Mentees. This provides a framework for Mentees to set their personal goals in the context of the Program and identify areas for development to work on with the Mentors. For both parties it provides guidance on personal and professional boundaries, and the nature of leadership in the Mentor role. Nimmons et al. (2019) highlights the need to set clear expectations for mentors regarding their roles and appreciation of professional boundaries. A Mentee signals formal commitment to the Program by signing an agreement, which is co-signed by the Mentor.

A key performance requirement for a Mentee is to drive their relationship with the dedicated Mentor and arrange a minimum of five meetings with the Mentor across the period April to October with the Mentor. The Mentees also are required to commit to attendance at the professional development suite covering topics such as developing, protecting and selling your professional brand, professional networking, and business strategy. During the operational phase April – November, Mentee and Mentor meetings occur where Mentees work on their personal and career development goals. Additionally, Mentees attend the professional development sessions, including masterclasses, offered by prominent local business identities. Program Overviews for Year 1 and Year 2 are provided in Appendix B. A feature of this Program is the invitation offered by the Executive of highly respected organisations to share their strategic business insights, and the opportunity to meet with the senior management team. The Program Managers monitor progress with a number of check-ins for the Mentees. The Program culminates with a celebration event by invitation where Mentees present on their learnings and progress in relation to achievement of goals. Celebrating success is embedded as a ritual of the Engage Mentor Program. Celebrating success is a very powerful motivator because it recognises the right effort and the power of achievements. It also, serves as a boost to self-esteem and it motivates to take the next step towards achieving the next goal. It creates a ripple effect of inspiration and opportunity.

The design of the Engage Mentor Program draws on aspects of Programs in operation in many leading Australian University Business Schools, which operate varying mentor programs as an integral part of the student experience. Research also was undertaken of mentor programs

operating successfully in the business arena, for example, Aurecon, which prompted the inclusion of a collective approach to learning to complement the dedicated Mentee/Mentor relationships. The Engage Mentor Program has established a core framework, which focusses on employability and transition to work, and a bespoke and tailored response to meet the needs of the respective Mentee cohort and unique features of the regional setting. Such is the agility of the Program. The model leverages longstanding collaborative relationships between the School of Business and Law Mackay and the local business community. For students, the Program provides insights into potential career opportunities in this region and the benefits of pursuing a career in regions (Barbeler, 2018; O'Brien, 2014; Susskind, 2012).

While the focus is the Mackay region, at a Meta level, the Engage Mentor Program aligns with a number of the United Nations Sustainable Development Goals:

- *Quality Education* (No 4)

- *Decent Work and Economic Growth* (No 8)

- *Partnerships for the Goals* (No 17).

Such a focus highlights the link to the broader context that our regional challenges are also global challenges we face to achieve a better and more sustainable future for all (United Nations, 2018).

The Engage Mentor Program launched in 2017 as a pilot with nine Mentees who were students of the School of Business and Law. Seven students were studying either a Bachelor's degree in Accounting (1), Business (5), or Law (1), and one student was enrolled in a double degree in Accounting/Business and another in Business/Professional Communication. All were on-campus students except one. The gender split was seven female and two males. All these students completed the Program.

In Year 2 (2018) nine Mentees also were selected. These students were studying a Bachelor's degree in Business (2), Accounting (1), and three students were enrolled in a double degree in Accounting/Business, and one in a Bachelor of Laws. Two students studying business related courses of Professional Communication and Digital Media also joined the Program. The gender split was eight females and one male. All but one of the students completed the Program.

There were 18 dedicated Mentors, and with the delivery of the professional development and Masterclasses, over 50 business professionals across a range of industries contributed to the Program across Years 1 and 2. Some of the Mentors also delivered into the group professional development. In Year 1, the gender split for Mentors was five males and four females. For Year 2, there were three male Mentors and six females. It was discovered that in Year 1, three Mentors, and five Mentors in Year 2 were CQUniversity alumni.

THE APPROACH

An Action Learning approach (Revans, 2011) was considered appropriate to the shared purpose of regional capacity building goals, and to the bespoke and evolving nature of the Program. Learnings are recognised, shared and utilised to tailor the Program as it grows. Learning is about mastering unknown challenges by working with others with identified shared purpose(s). Programs should be collectively designed and launched by those who hope to profit from them (Revans, 2011). The Engaged Collaboration Model has been developed recognising the specific context of people and place characteristics. Beer (2014) identifies the growing recognition that local or regional leadership is an important contributor to the growth of places (p. 254). Furthermore Beer (2014, as cited in Beer et al., 2018) highlights that the circumstances

affecting a region determines the capacity for leadership to emerge and shape how it is expressed. Staff of the CQUniversity School of Business and Law, Mackay, through well developed, engaged business relationships with the regional business community, were well positioned to act as a regional development leaders in proposing innovative capacity solutions.

The Engage Mentor Program utilises the Engaged Collaboration Model to shape the Program's establishment and evolution. The Engaged Collaboration Model Program (Figure 1) identifies the specific actors, and provides for a Collaborative Place, based on trust, respect and shared purpose between parties, to deliver tailored, regional solutions. (The generic model is provided in Appendix A).

Figure 1: Engaged Collaboration Model: Specific to the Engage Mentor Program

Key factors core to the model and underpinning the success of the Engage Mentor Program are:

- The presence of an independent, auspicing agency (in this instance CQUniversity School of Business and Law, Mackay as the university-in-place);
- Program Champions for the Engage Mentor Program (Program Managers);
- The 'resource pool' of CQUniversity Mackay Students (Mentees) – the target group for the Program;
- A supportive, engaged business community (Mentors and Professional Development providers);
- Strong, committed Program Sponsorship, with a high profile, committed industry partner and sponsor (Hail Creek Mine); and
- Well developed, supportive relationships between all parties, with a strength of shared purpose to grow collaboratively generated solutions.

The Engage Mentor Program is an example of applied transformative learning which relies on critical reflection as key to the learning experience (Merriam, 2004; Hansman, 2016). Mezirow's transformative learning theory emphasises rational thought and reflection. The student Mentees of the Engage Mentor Program, with the support of their dedicated Mentor(s) and complemented by the professional development suite *"… are challenged and empowered to become self-aware and to examine critically their beliefs, values and knowledge"* (Steenkamp, Franettovich, Collins, & Tyler, 2017).

The success to date of the Engage Mentor Program aligns with Hambleton's (2018) view emphasising regional university campuses as catalysts for regional economic growth characterised by strategic capability building and brokering, to enable innovation within and across institutions. Kinnear and Ogden (2015) advocate that regional universities are useful in fostering collaboration and connectedness (p. 7). CQUniversity, as the Independent Auspicing Agency, along with the Program Managers as Champions, is central to brokering the key relationships and the innovative outcomes generated through collaborative place to deliver the Engage Mentor Program.

LEARNINGS

The Engage Mentor Program in 2017, enjoyed a positive launch and was well received by students, business professionals, whether Mentors or contributors to the professional development, and was well regarded by colleagues within the University, as well as gained endorsement from the Dean. The General Manager of the industry sponsor also took an active interest in the Program's progress. Students were genuine and active in their participation, and their feedback reported that goals has been achieved and acknowledged various growth in personal attributes relevant to workforce transition and career success. Mentees saw value in participating in the Program. Mentees were actively encouraging other students to apply. Mentors also provided positive feedback and were willing to 'sign up' for 2018. The conversations existing Mentors and other professional contributing to the Program had in their respective networks regarding the Program's value resulted in an oversubscription of potential Mentors. The Program attracted positive media coverage within and external to the University. This 'success' was strong motivation for continuation into Year 2 of the Program.

During the operational phase of the Engage Mentor Program, and aligned with an open and innovative approach, some of the program components unfolded organically (for example, the professional generosity of volunteer Mentors providing in-depth insights into business operations). Also an unexpected benefit to the program was the high calibre of the professionals willing to be involved. This also was publicly acknowledged by the General Manager of the industry sponsor

Effective learning follows the process of reflecting on experience (Mezirow, 2009). To learn from program outcomes, feedback was continually collated (action learning) from Mentees and Mentors and professionals involved with the program in Year 1 and Year 2. The Feedback from Year 1 was used to inform the content for Year 2. Additionally, seeking feedback provided an opportunity for further reflection by the Mentees in particular, supporting the view that that critical reflection is a key element in any type of mentoring relationship or formal mentoring (Hansman, 2016) and central to transformational learning (Brookfield, 2000, as cited in Merriam, 2004, p. 62). In Year 1 all Mentees believed that the Program had met expectations, along with the Mentors.

The dedicated Mentee and Mentor match was supported as fundamental to the learning and

ultimately the success of the experience for the respective participants. Mentees reported they achieved their respective personal goals by participating in the Program. One Mentee's feedback (2017) reports *"The Mentor Program has given me countless opportunities to build my confidence, which will be a huge asset to me in my future careers"*. This growth of individual professional capability of the Mentees was highly visible as the Program progressed and endorsed by the Mentors. Mentees agreed that the goals they had set for the Program had been achieved.

A selection of feedback from Program's Mentors and Mentees highlights the range of benefits:

It was a huge honour to be part of the Mentor Program; not only did it teach me some valuable employment information but also it developed my confidence in conducting myself. Having a mentor that is linked to the Mackay Region gave me an insight into their lives and helped me in developing professional working relationships (Mentee, 2017).

I've gained much fulfilment from seeing my mentee grow in self-confidence and career direction follow our meetings and discussions (Mentor, 2017).

[My Mentor] has encouraged me to find my voice and be confident to express myself and be heard. He's shown me how to update my online profiles so that I stand out to prospective employers. I know now that I have the potential and opportunity to achieve great things (Mentee, 2018.)

It's very exciting to meet your Mentee and grow professionally on this journey with them. Some of [my Mentee's] questions throughout the year have allowed me to reflect on challenges and ideas that I may not have ordinarily considered (Mentor, 2018).

If you keep working hard, the opportunities will present themselves; and always make sure you operate with honesty in every situation – these are only a couple of the important concepts I learnt from my mentor. [My Mentor] also provided invaluable advice on the presentation of my resume and helped me hone my interview skills (Mentee, 2018).

Over the year, [my Mentee], has become more confident in the direction she wants her career to take, and I've helped her set genuine goals for the future. On a personal note, this program has helped me to develop my mentoring skills and expended my own knowledge of how CQUni's Business Degrees are run (Mentor, 2018).

Thanks to my Mentor – who stressed to me the value of work experience – I was motivated to apply. and was offered a work-experience placement. At this point I'm taking advantage of all the professional development opportunities I can to better myself and learn what kind of career may be suited to me (Mentee, 2018).

I was pleased I could encourage [my Mentee] with some of the additional extra-curricular activities she took on, including mentoring and supporting other students. The questions she asked made me pause for thought and forced me to rise above my day-to-day activities in order to explain what I was doing, where our organisation is going and why (Mentor, 2018).

The value of the Program was highlighted by the Dean, School of Business and Law: *Our students of today are – quite literally – the future leaders of our communities; engagement opportunities such as this provide our students with a competitive advantage.*

It was encouraging that the Program's developing reputation provoked increased engagement

from the region's business professionals from Year 1 to Year 2. Mentee and Mentor advocacy for the program throughout Year 1 and into Year 2 was welcomed as a key achievement and has strongly contributed to program sustainability and growth. Mentor applications for Year 2 of the Program doubled from Year 1 of the Program. To benefit from those Mentor applicants that were not matched with a dedicated Mentee, these professionals were invited (where relevant) to deliver a Masterclass or to contribute to the Professional Development suite. Mentees attended a series of Masterclasses and professional development as part of the Engage Mentor Program. The Mentees attended these sessions without the Mentors.

The Mentees' top four Professional Development were

- Developing and protecting your professional brand
- Step up your Career Savvy Career Development Forum and
- The Story of Mastermyne Group Limited
- The Business of Mastermyne Group Limited and site visit

The Mentors' top four areas they felt were of greatest benefit to a Mentee as professional development were

- Developing and protecting your professional brand
- Professional networking
- Job applications
- Transition to work

The Program Managers have exercised a collaborative management style and, consistent with an action learning approach (Revans, 2011), adapted program delivery, taking systematic action as, and when, required to resolve specific Program issues, and to customise the Program to best deliver desired outcomes. As an example, outcomes from Year 1 of the Program contributed to the publication of a Handbook for Mentee and Mentor use during Year 2 of the Program, and a more formalised Program Induction.

The extent of the 'hands on' nature of Program Manager(s) input required to deliver the Program successfully was not originally anticipated, and in Year 2 various modifications were made to Program delivery to more efficiently manage for this. In Year 1 of the Program, one or both Program Managers attended all Professional Development sessions with the Mentee cohort. In Year 2 a more hands-off approach was trialled with the Program Managers not remaining with the Mentees for the duration of the professional development sessions, thus allowing the cohort more autonomy when interacting with the presenters. This was not as successful as anticipated. As a collective the Year 2 cohort was observed as apparently more passive, reserved and reticent (than the Year 1 cohort) in actively engaging with the presenters (with some individual exceptions). To address this issue for future delivery of the Program, the nature and configuration of the Mentee briefing will include a full day 'Program Immersion'. The aim is to foster more cohesion in the Mentee cohort, establish and reinforce professional etiquette, and specific performance expectations, and stimulate more active and reflective learning.

Based on Year 1 and Year 2 completion, the areas of Engage Mentor Program delivery which were *less difficult* than anticipated by the Program Managers were:

- The strong, maintained shared purpose and collaboration (the Collaborative Place) for the Program;

- Program Sponsorship – continued active endorsement from Hail Creek Mine representatives, and from the Dean, School of Business and Law;

- The level of professional generosity provided by the Mackay business community to the Program;

- The exceedingly high calibre Mentors applying to the Program;

- The excitement and energy surrounding the Program – people just wanted to 'be part of it'.

Areas of the Program, which were identified as *more difficult* than anticipated and required intervention by the Program Managers included:

- The Mentee Cohort Dynamic – the Mentee group from Year 1 were observed as more outgoing, confident and willing to engage in contributing to program development. The Year 2 cohort included some Mentees less active within the Program.

- Program Management – the Program Managers' more 'hands off' approach was not as successful as anticipated;

- Resourcing – insufficient time and resourcing was available to best implement supportive technology for the Engage Mentor Program.

- The Model for Transferability – work has progressed, and many elements are now in place to allow for transferability to other regions/places, however this is a *work in progress and will continue to evolve.*

- The change in ownership of the original industry sponsor's regional business asset significantly impacted project momentum. The scale of the impact had not been anticipated and was a factor in the delay in Year 3 implementation.

The Engage Mentor Program is one approach to take up the challenge of leveraging the 'demographic dividend' of young people in The North. It places demography, often overlooked in this part of regional Australia, as one potential source of competitive advantage directly in the spotlight (Regional Australia Institute, 2015). While securing a job was not a stated outcome of the Pilot, graduates of the Engage Mentor Program have secured employment in their desired professional fields locally, or are undertaking further study. A 2017 Mentee who gained permanent employment reported *"I am enjoying every aspect of the job. It's great to be able to reflect on what I studied at Uni and be able to put it all into practice. Every situation is a learning opportunity and I am enjoying every second of it"*. In both Year 1 and Year 2 of the Program, Mentees 'Learned to Stay'.

CHALLENGES

Nimmons et al. (2019) while extolling that the benefits of mentoring programs are well recognised, it is accepted that the delivery of such programs are confronted with a number of challenges, which tends to vary depending on the nature of the program. In terms of program success, sustained mentor and administration staff motivation is a prerequisite (Nimmons et al., 2019). For the Engage Mentor Program, the constant challenge was appropriate resourcing by the Program Managers within the context of other role requirements.

Near mid-way through Year 2, the Program Managers were advised that the industry sponsor was intending to divest its regional asset and when executed would no longer have a presence in the region. The sale occurred sooner than expected and staff changes followed. This created a level of uncertainty despite the sponsoring support for the Program already secured for Year 3. The new ownership operated a different model of community engagement, which was

managed from outside the region. The absence of a regional physical presence of the industry sponsor has altered the interactions and the absence of the close working relationship enjoyed with the former entity did leave a void. The exit of the place-based leaders of industry partners, (General Manager of Hail Creek Mine and the Community Relations Advisor) who had direct professional input to the program caused disrupted. It also changed relationships with the business. The professional network available that was readily contributed from the industry sponsor to participate in the program was less forthcoming. In Year 1 and Year 2, a minimum of two Mentors each year were provided to the Program by the sponsoring industry partner. Also, a key pillar of the group professional development includes a visit to site operations, where a tailored range of activities were organised, including sessions with managers, and a round table with more recent graduates across a range of disciplines working on-site. Moving into year 3, the changes in ownership and engagement resulted in a depleted direct professional contribution to the program. In addition, the strong professional advocacy provided by its senior staffing of Rio Tinto Hail Creek as sponsoring partner and associated stature this brought to the Engage Mentor Program was not readily available with the new owner. Due to logistics, among other factors, it has proved more difficult to establish a new working relationship.

Some internal changes in workload focus within the School, also impacted Year 3. While complementary to learning and teaching, the Engage Mentor Program was regarded as an engagement activity and not core business. This impacted the Program Managers in terms of direct resourcing to the operate the Program. There was initially a delay to launching and operationalising Year 3. Given the professional reputation with various stakeholders, this was not ideal; student applications had been received and there was some promotion with potential Mentors and receipt of Expressions of Interest. Due to core business activities, the Program Managers came to the decision that year 3 would not run as intended and a review of the Program was required to consider purpose, impact, sustainability and integrity.

The benefit of this business disruption relatively early in the Program necessitated some considered reflection on Program scope, delivery modes and operational requirements. Clearly there was a need for innovation. The extent of hands on role of the Program Managers was not sustainable. The challenge was to provide more efficient delivery of the Program without losing the bespoke nature, integrity and characteristics that had contributed to its success to date, including the dedicated personal face to face Mentee-Mentor relationships. To provide the rigor and consistency, Mentees will be required to be more accountable for their learnings and formally record their progress against goals within a dedicated system. To this end e-learning options also are being explored, which may see a move to a form of online and e-mentoring (e.g. similar to the Aurecon model) for the delivery of the group professional development.

THE FUTURE PROGRAM

The Engage Mentor Program is an innovative approach to regional professional capacity building, aiming to retain local business students to work regionally. The program incorporated the understanding of traditional Mentor program implementation and research, and an indepth understanding of the local business region and business student professional toolkit needs, to develop a bespoke, hybrid mentoring model. The Engage Mentor program was undertaken as a Pilot program in 2017 (Year 1), with a second Year of the Program (Year 2). Although Year 3 of the Program had been planned and is funded, a series of business disruptions has provided the opportunity to pause for reflection on Program successes and challenges and the requirements needed to sustain and grow the Program. Continuation of the Program in its original format is not sustainable, nor will provide an effectively scoped model for transferability of the program, given the resource-intensive nature of the contributions required

from Program Managers. Future stages of the Program will see an increased focus on robust research in terms of the Program's components and experiences of the key actors. Resourcing will be allocated to establishing e-mentoring options, capturing professional development content for more mainstream distribution, and focussing on the Program's key elements that fed the success of the Program in its two first years. The Engage Mentor Program has achieved its goals of sustainability through collaboration. Innovation due to disruption is now required to ensure its continued contribution to regional capacity building.

The Engage Mentor Program is an effective model for transformation place-based leadership and professional collaboration to drive regional capacity building. There is opportunity for the Engaged Collaboration Model (refer Appendix A) to be adapted to other regional contexts, which does not include a University led initiative for its students. It is fundamental to identify the relevant actors of the model and to build the relationships based on trust, respect and shared purpose for collaborative place. A potential implementation could include, for example, a Chamber of Commerce as an auspicing agency for new entrants to the workforce, whether at graduate level or otherwise.

The Engage Mentor Program has benefitted greatly from the range of high calibre Mentors forthcoming from the business community. The Program Managers will continue to foster this involvement. The role of past Mentees as 'Program Alumni' and informal Mentors into the Program will be further explored. The Program may expand to incorporate other discipline areas within the University where Engineering students will be invited along with Business, Accounting, Law, Engineering, Digital Media and Professional Communication disciplines. The Mentor base correspondingly also will be extended in scope.

Based on outcomes from Years 1 and 2, support for a further year was secured from the Industry Sponsor through the continuation of the Community Development Fund despite a change of ownership of the regional business asset from Rio Tinto to Glencore. Resourcing, financial and otherwise, is less certain beyond Year 3, therefore a key focus for Program Managers will be reviewing, not only financial, but also, operation sustainability. Interest has been received from others in the business community to fund the Program. A future challenge is establishing a sustainable collaborative model for the Engage Mentor Program, and one that may be transferrable to other regions.

The Engage Mentor Program has achieved its aim of positively contributing to the region's business vitality by building professional capital and fostering an environment for retention of locally educated business students while growing mutually beneficial business relationships. The Program's Mentees 'Learned to Stay'.

It is acknowledged that the contemporary business environment is characterised by volatility, uncertainty, complexity and ambiguity. It is imperative to continuously bring a disruptive lens to collaboration in the regional business environment to drive innovation in regional capacity building.

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APPENDIX A

Figure 2 Engaged Collaboration Model: Generic Actors

APPENDIX B

Table 2 Overview of Timeline and Professional Development Suite of Engage Mentor Program

When	Year 1	Year 2
January – February	Call for Mentee applications; Call for Mentor Expressions of Interest	Call for Mentee applications; Call for Mentor Expressions of Interest
February – March	Check all applications for eligibility	Check all applications for eligibility
March	Selection Interviews Offers to participate Mentees and Mentors Matching Process (driven by Mentee's needs) Advice of Dedicated Mentee – Mentor pairings Induction for Mentees and Mentors	Selection Interviews Offer to participate Mentees and Mentors Matching Process (driven by Mentee's needs) Advice of Dedicated Mentee – Mentor pairings Induction for Mentees and Mentors
April	Launch Event Masterclass: Developing and Protecting your Professional Brand including Linkedin	Launch Event Step up your Career Savvy – Career Forum Mentee Briefing: The Importance of Business Etiquette Masterclass: Developing your Professional Brand including Linkedin
May	Mentee – Mentor Meetings; Step up your Career Savvy – Career Forum	Mentee – Mentor Meetings; Masterclass: Developing your Professional Brand
June	Mentee – Mentor Meetings; Masterclass: The Story of Mastermyne Check-Ins for Mentees	Mentee – Mentor Meetings Selling your Professional Brand (Writing Job Applications/Resume Content) Masterclass: The Business of Mastermyne Group Limited and Site Visit Check-Ins with Mentees
July	Mentee – Mentor Meetings Masterclass: The Mackay Airport Story	Mentee – Mentor Meetings Masterclass: The Business of Hail Creek Mine and Hail Creek Mine Site Visit Selling your Professional Branch (Interview Skills)
August	Mentee – Mentor Meetings; Masterclass: The Importance of Community Service Masterclass: Professional Network Nous with Young Professionals Mackay Check-Ins with Mentees	Mentee – Mentor Meetings Masterclass: Professional Networking Event with Young Professionals Mackay Check-Ins with Mentees

When	Year 1	Year 2
September	Mentee – Mentor Meetings; Masterclass: Working with the Media Masterclass: How to get that job and ace the interview?	Mentee – Mentor Meetings Masterclass: The Business of Tandy Group
October	Mentee – Mentor Meetings Masterclass: The Business of Mastermyne and Mastermyne Site Visit Masterclass: The Business of Hail Creek Mine and Hail Creek Mine Site Visit Check-Ins with Mentees; Briefing for Celebration Event	Mentee – Mentor Meetings Masterclass: Protecting your Professional Brand (The Legal Necessities) Masterclass: A Career Conversation with Alexandra Gartmann Managing Director Rural Bank Check-Ins with Mentees; Briefing for Celebration Event
November	"ENGAGED" 2017 Pilot Celebration - Engage Mentor Program	"ENGAGED" 2018 Celebration - Engage Mentor Program
November – December	Review and Reporting to Industry Sponsor Planning for next year	Review and Reporting to Industry Sponsor Planning for next year.

Key stakeholders' perceptions of extreme weather impacts on tropical fruit businesses in Central Queensland, Australia

Sabrina Haque, Delwar Akbar and Susan Kinnear

Central Queensland University, Australia

Email: s.haque@cqu.edu.au

ABSTRACT

Extreme weather events (EWEs) such as heatwaves, droughts, cyclones, severe storms, floods, hail and frosts have detrimental impacts on tropical fruits, disrupting supply chains and business systems. The central east parts of Queensland are vulnerable to EWEs due to their subtropical coastal climate; yet this region produces most of Australia's tropical fruits. This paper examines key stakeholders' perceptions about the business impacts of EWEs on tropical fruits in Central Queensland as well as their proposed adaptation strategies. This study adopted an exploratory qualitative research approach, through in-depth interviews with nine key stakeholders supported by open ended questions added in the farmer's survey. The interview data have been primarily analysed by both thematic and narrative methods. The research found that tropical fruit production was affected by extreme weather, and EWEs have consequences at all levels of the supply chain, as well as directly impacting individual fruit farming businesses. Almost all the participating stakeholders suggested that functional collaboration among the key stakeholders could help to reduce the negative impacts of EWEs.

Keywords: Climate change, sub-tropical Queensland, horticulture and adaptation strategy.

1. INTRODUCTION

In the recent years, Australians have witnessed severe heatwaves, cyclone and flood events due to an increase of surface air temperature by 1°C (CSIRO, 2018). These EWEs have resulted in substantial impacts on tropical fruits in Australia (Mditshwa et al., 2019). The state of Queensland produces one third of Australia's fruits (QFF, 2019). The central part of Queensland's eastern coastline has very favourable climatic properties to grow tropical fruits, with around 29 fruit farms producing crops at commercial volumes (ABARES, 2019). In recent decades, the region's climate has changed significantly and, consequently, this has affected fruit farming industries. Recently, the mango industry representatives of Australia were informed by experts that new adaptation strategies and plans for proactive changes in the way of running business are needed to be able to remain sustainable (AMIA, 2019). Here, adaptation refers to the way of adjusting and reducing or avoiding the adverse impacts of present and future EWEs (Ridoutt et al., 2016).

The adverse consequences of EWEs could be minimised by initiating proper adaptation measures as well as evaluating stakeholders' perceptions regarding this issue (Nunfam et al., 2019). Using stakeholders' opinions in climate change adaptation studies (i.e., EWEs and agriculture) is very important (Kiem & Austin, 2013), and this may help to understand the

impacts of EWEs through the whole supply chain, developing response processes and overcoming potential barriers. In a previous research, relevant stakeholders provided substantial information regarding impacts of EWEs', current adaptation strategies and barriers of fruit farming businesses (Gillham, 2000). Never (2012) also found, the interview participants' organizational role can affect their opinions on types of adaptation strategies of EWEs on tropical fruit businesses. Some studies have focussed on the impacts' of EWEs on grapes (Dahal et al., 2019) and pome fruits (Thomson et al., 2014); but few studies have focused on tropical fruits in Australia. Besides that, most studies have used quantitative data to identify the EWEs' impacts and adaptations. To fill this gap, this study has modelled the stakeholders' perceptions on tropical fruit farming businesses associated with existing and future adaptation strategies in terms of EWEs' impacts and consequences in the sub-tropical Queensland region.

Several studies have used qualitative research approaches to identify the existing and future adaptation plans as well as obstacles of implementing adaptation options for farming businesses in terms of EWEs. For example, Mbakwe, Judith and Obaji (2016) explored Nigerian farmers' perceptions on weather variables and adaptation strategies and revealed that EWEs have impacted Nigerian agriculture substantially over time and insufficient information is the main difficulty preventing the implementation of new adaption options. A qualitative study has been presented by Azhoni and Goyal (2018) which involved stakeholders from different parts of the farming business supply chain (e.g. organisations, policy makers, researchers and farmers) to discover each sectors' perceptions regarding climate change impacts and responses; this study concluded that information sharing and collaboration among policy makers, researchers and government is highly recommended to reduce the consequences of EWEs. Brown, Bridle and Crimp (2016) and Brown et al. (2015) also derived very similar results by conducting 14 different focus group discussions; additionally, Brown et al. (2015) revealed that farmers also need proper training and more funding.

This paper aims to understand stakeholders' perceptions of the business impacts of EWEs along with existing and future adaptation strategies of fruit farming businesses in subtropical Australia through a case study of Central Queensland. The paper is organised as follows: the case study area description is given in section 2, section 3 describes the methodology, section 4 presents the findings and analysis and the paper concludes in section 5 by describing key conclusions & future research.

2. CASE STUDY AREA

The study was carried out in a sub-tropical Queensland region which lies approximately between latitudes 23°26' S~13°78"S and longitudes 144°53'E~5°80"E. The region is in the central part of the Queensland's eastern coast line (Figure 1). The mean daily maximum temperature is 30°C to 38°C and annual average rainfall is 600mm (DEHP, 2016).

This region is vulnerable to several types of EWEs such as cyclones, floods and heatwaves (CSIRO, 2018). This region is a production zone for a number of tropical fruit crops grown in Australia, including lychee, pineapple and mango.
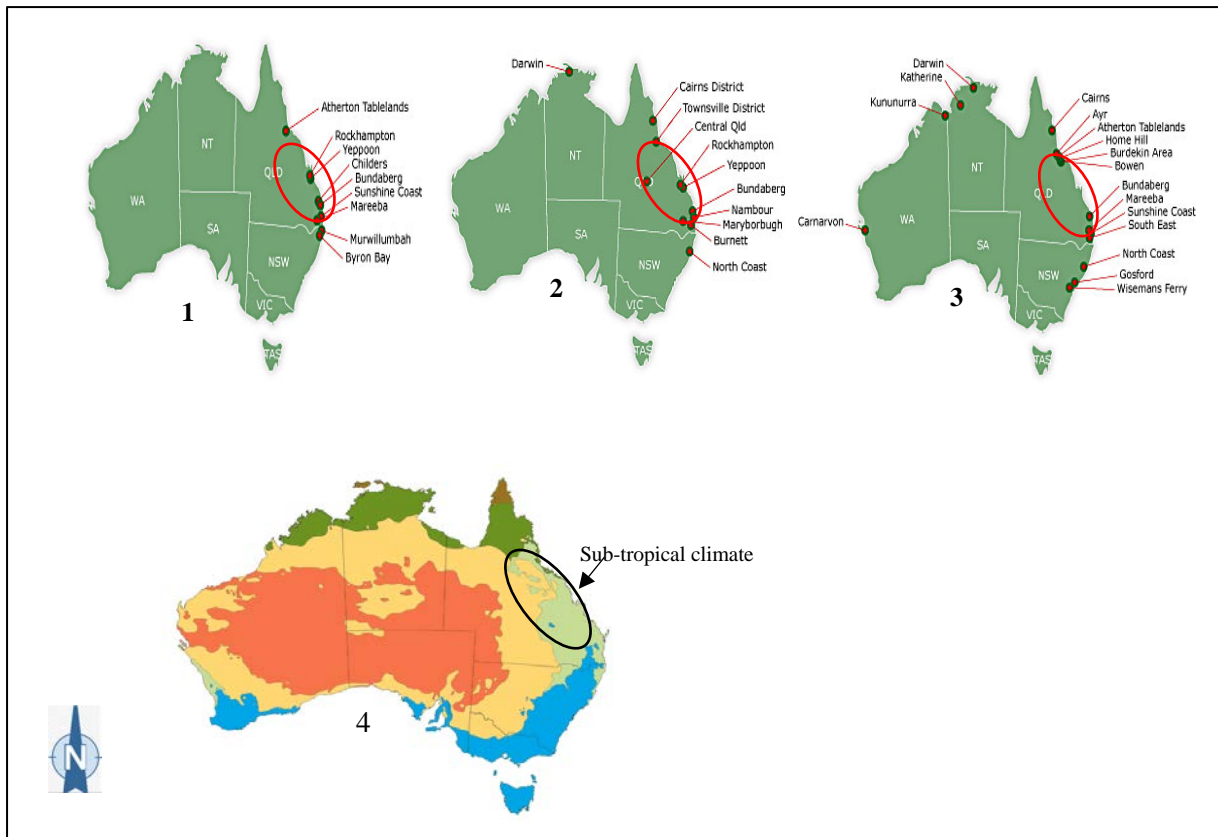
Figure 1: The Case study area, as shown by circled areas. Top panel: (1) Known commercial Lychee production zones in Australia; (2) Known commercial pineapple zones in Australia and (3) Known commercial mango production zones in Australia. Not shown are small-scale commercial mango farms that exist in Central Queensland (Rockhampton, Yeppoon, Emu Park and Gracemere regions). Bottom image (4): the sub-tropical climate zone in Queensland. Source: Adapted from (SML, 2019; Weebly, 2019).

3. METHODOLOGY

This study adopted an exploratory qualitative research approach through an in-depth interview method. An open-ended interview questionnaire was developed to conduct the interviews. The targeted key stakeholders were chosen from four directly affected sectors (Kiem and Austin, 2013): fruit farmers represented by industry body, governments, agri-finance institutions and transport companies. In addition, local experts were also included in this study. Of these participant types, this study included interviews with three industry personnel, one state government employee, one local government employee, two financial insurance representatives, and two agri-academic expert personnel. Unfortunately, despite several attempts to contact them, it was not possible to secure participation from transport companies who carry the produce to the market. However, government stakeholders and the experts helped this study to fill this gap to identify the EWEs on transport sector and their subsequent impacts on the other supply chains.

The interview participants were recruited initially from professional contacts within the research team, then extended by snowball sampling (Somboonsuke et al., 2018). Ethical clearance was obtained from the Human Research Ethics Committee (approval no. 21036), prior to contact with respondents.

The interview method offers an opportunity to realise the extent of existing adaptation options

as well as issues and challenges of executing new adaptation strategies for EWEs in farming industries (Azhoni & Goyal, 2018). The interview respondents participated in the interviews via face to face and or telephone methods, according to their convenience. The interview conversations were recorded verbatim and the researcher developed field notes. After transcription, both thematic and narrative methods were used to analyse the stakeholders' perceptions about the impacts of EWEs on tropical fruit businesses in sub-tropical Queensland.

The thematic analysis refers to "the method which helps to identifying , analysing and reporting patterns within datasets" (Castleberry & Nolen, 2018, p. 808). The narrative analysis describes the substances of stories within the datasets (Allen, 2017). Here, the thematic analysis explored the major themes and sub-themes. However, the number of participants is limited to nine; therefore, a quantitative thematic analysis is not meaningful instead of adding narrative analysis to understand the substances of stories under each theme.

In addition, a grower's survey was conducted with 38 tropical fruit farmers in Central Queensland. In addition to the 28 structured survey questions, the questionnaire also included two open-ended questions about key impacts and adaptation strategies of EWEs. Responses from these two open-ended survey questions were combined with the interview data to add richness to the findings. In particular, this enables the stakeholders' perceptions to be further analysed by matching similarity or uniqueness of farmers' perceptions with stakeholders' perceptions.

4. FINDINGS AND ANALYSIS

The perceptions across the different interview types (such as industry bodies, state and local government employees, and agri-academics) were analysed by using both thematic and narrative methods. The preliminary findings indicated that most stakeholders believed EWEs were a source of negative impacts on fruit farming businesses. Overall, it appeared that, whilst some existing adaptation strategies were in place to help minimise the consequences of extreme events, this situation could be improved through better functional collaboration amongst the relevant sectors as well as via proactive self-preparedness. In total, five key themes and sub-themes were identified from the dataset (Figure 2), according to the main discussion areas of interview datasets. Here, the themes reflect the principal focus of the interview discussions (Maguire & Delahunt, 2017). The key themes covered a wide variation of aspects of fruit farming businesses in terms of EWEs' impacts and adaptation strategies in the sub-tropical Queensland region.

4.1 Impacts and consequences of extreme weather events

Most respondents indicated that heatwaves, bushfires, droughts, floods and cyclones are the key extreme events in the case study region; two respondents mentioned frost events and one interviewee mentioned hail events as an EWE. The stakeholders mentioned two categories of impacts that were faced during extreme weather events: on-farm impacts and off-farm business impacts.

Key on-farm impacts that participants mentioned were the direct loss of fruits, decreases in fruit quality, damage of infrastructure and other impacts on fruit production. For example, one respondent mentioned, *"…those things (EWEs) impact our business and firstly, they impact the growers because the growers are independent farms and businesses, and so these events impact the growing conditions and the yields and the quality of the fruit in different ways at different times."* The off-farm impacts that were also frequently mentioned by most respondents included transport and market disruptions. Half of the interviewees indicated that

the entire supply chain of the fruit farming business as well as the broader Australian agri-business have been impacted by EWEs.
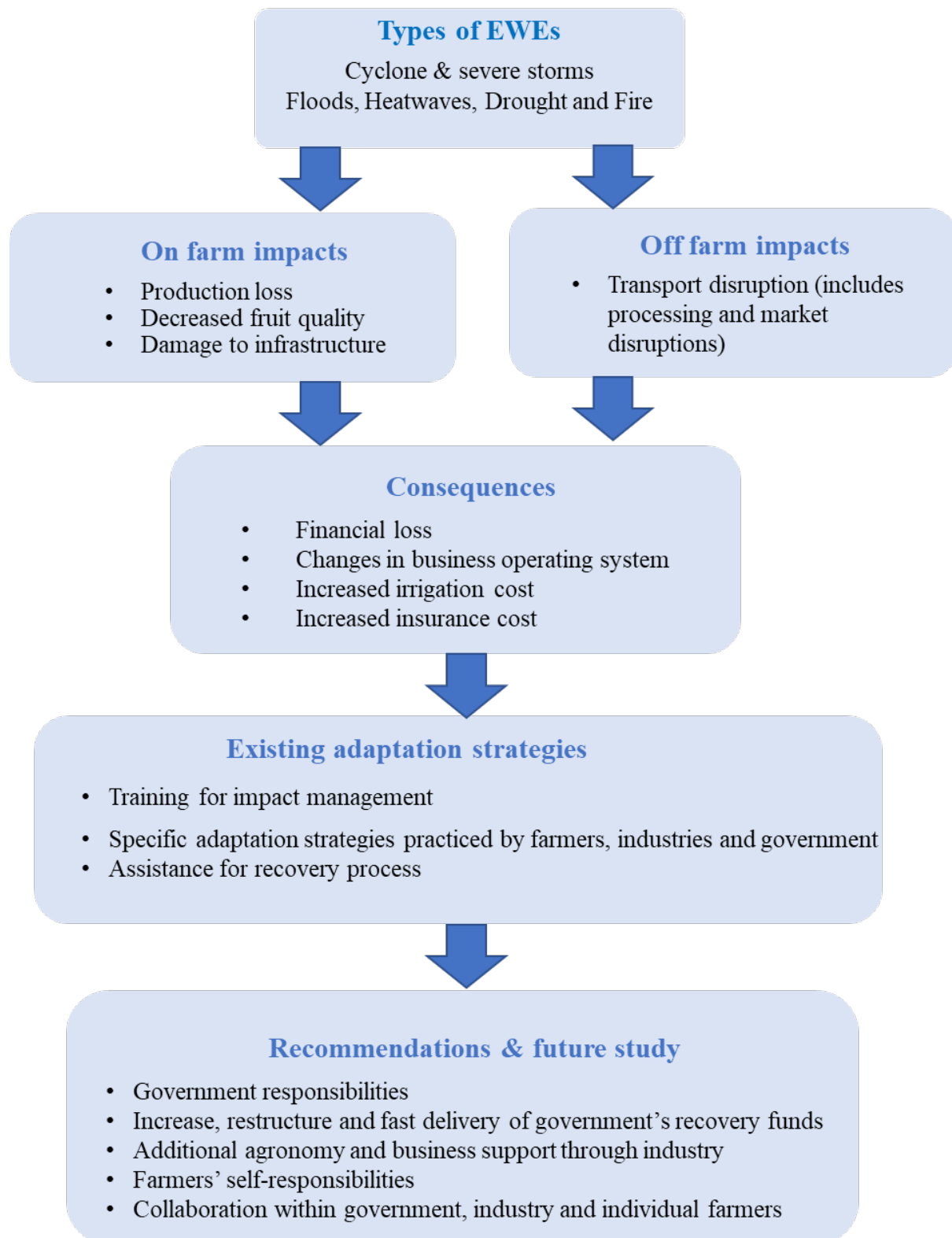
Types of EWEs

Cyclone & severe storms
Floods, Heatwaves, Drought and Fire

On farm impacts

- Production loss
- Decreased fruit quality
- Damage to infrastructure

Off farm impacts

- Transport disruption (includes processing and market disruptions)

Consequences

- Financial loss
- Changes in business operating system
- Increased irrigation cost
- Increased insurance cost

Existing adaptation strategies

- Training for impact management

- Specific adaptation strategies practiced by farmers, industries and government
- Assistance for recovery process

Recommendations & future study

- Government responsibilities
- Increase, restructure and fast delivery of government's recovery funds
- Additional agronomy and business support through industry
- Farmers' self-responsibilities
- Collaboration within government, industry and individual farmers

Figure 2: Key themes (orange boldface) and sub-themes mentioned by the stakeholders during interviews. (Source: Adapted from interview responses conducted by researcher, mid 2019)

All of these on-farm and off-farm impacts reported to have occurred during or after EWEs were recognised as having several consequences on farming businesses.

The most repeatedly mentioned consequence of EWEs was changes in the operating system of all businesses or organisations involved in the fruit farming business; in this regard, one participant from the state government mentioned that, *"... it (EWEs) alters the sorts of programs that we were aiming to deliver."* Some EWEs have long-term consequences (such as financial loss) which were repeated in a number of interviews; for example, one respondent said, *"...cyclone blew all the trees over and farmers can't grow citrus fruits no longer or following years."* The extreme events caused financial losses of businesses, especially where this interrupted future cash flow in the following years. These financial losses occur in many ways such as by damaging fruits, decreasing fruits' quality or by adding extra costs for fencing and netting, harvesting and storing, irrigation and insurance. Sometimes, floods and water blockages caused the death of fruit trees by attracting post-flood diseases and pests as mentioned by one interviewee who was an industry representative. Three of the interviewees were aware about negative impacts on fruit farmers' physical and mental health after an extreme event has happened which has long-term consequences.

Therefore, it was clear from the range of interview responses that the impacts and consequences of EWEs are being felt across fruit farming businesses of Queensland as well as agri-businesses of Australia in a range of ways. In addition to this, the farmers' opinions regarding EWEs' impacts and consequences (derived from farmers' survey) also supported the findings from the interview data analysis.

4.2 Existing adaptation strategies for extreme weather events

This section explores the existing adaptation strategies for fruit farming businesses of the sub-tropical Queensland region as reported from interview discussions. Currently, some training programmes are taking place, having been offered by government and industry to minimise the impacts of EWEs. Some specific adaptation strategies are also practiced by the farmers, industries and government as well. For example, a respondent from the state government mentioned that, *"implementation of good practices based on prior experiences of extreme events can be an effective way of preventing similar levels of impact."* Some participants of the farmers' survey also mentioned this adaptation option. The farming industries' peak bodies also provide some assistance for the recovery process in post-event circumstances, but it appeared that this level of assistance was not enough to respond to the needs of all farmers in the region. In this regard an interviewee stated, *"... we don't always have the resources to go out straight away and just go and help the farmers sometimes because that's out of our projects."* The Australian government also provides some disaster relief if the farmer becomes eligible for a relief package, however this does not cover all financial losses borne by the business. The information gathered from farmers' survey also indicated that, the government's relief funds do not cover all the claimed losses. Nonetheless, the stakeholders suggested some ways to improve the existing adaptation options to make them both quicker (i.e., fast delivery of government's recovery funds) and more effective.

4.3 Future strategic recommendations for extreme weather events

When asked to provide recommendations about future preparedness of the region and its fruit industries to EWEs, the participants shared a range of opinions, but these appeared to be mostly given from a generic perspective. There were few specific suggestions made and most participants referred to extending existing practices, rather than nominating innovative of creative responses. For example, the stakeholders' opinions indicated that there are some adaptation options that exist for the fruit farming businesses which derived from the previous section. The stakeholders recommended some strategic ways to improve the current adaptation strategies to be more affordable and effective for fruit producers and associated industries. All individual interviewees mentioned at least one or more times that the role of government

includes responsibilities such as enhancing strategic supports for the farming businesses. Most of the interviewees indicated that the disaster relief and recovery funds needed to increase, and that the paperwork process should be restructured to make it easier for farmers to obtain relief. There were also suggestions that industry-level agronomy and business support need to be increased for fruit farming businesses and the overall agribusiness in Australia. A representative of industry sector mentioned in this regards that, *"…in my opinion, the whole system needs to be rejigged. There is some work under way on the drought side of things, but I think nationally we need a natural disaster strategy because, we are going to see these events continue, possibly more extreme events and more often. Recently we have seen that those grants have been lifted to $55,000, but again, it still doesn't go very far. You need concessional loans. They're a great opportunity, but the nature of horticulture businesses is too …heavily debt loaded, so they don't fit the need."* Six of the respondents' believed that, along with other adaptation strategies, producers accepting self-responsibilities (e.g., applying proactive preparedness and planning) play a crucial role to minimise impacts and recover from extreme events. In addition to that, farmers indicated the need to be more updated in terms of impact management guidelines as well as information regarding available training, assistance and financial support. The respondents stated repeatedly that the effective way to minimise the adverse impacts of EWEs' is functional collaboration among local government, federal government, industry sectors and producers. A financial advisor representative shared an opinion in this respect, *"…adaptation should be better communication between the grower themselves, government departments and industry bodies."* Some stakeholders also suggested some other adaptation strategies which are also subject to consider. Three of the respondents thought that choosing appropriate land to establish fruit farms could be one of the long-term adaptation strategies for new farmers, as it is possible to reduce the risk of flooding and sometimes even storms by careful choice of location. It was also indicated that it is necessary to help farmers to mitigate the risks by offering affordable crop insurance via government subsidy.

In terms of recommendation, the participants in the farmers' survey were unsure about their future adaptation options to minimize the further impacts of severe future EWEs'. Most of the farmers mentioned that, if they could have financial support from government and/or at the industry level, then they will be able to afford insurance for their crops and properties.

The findings of this study indicated that EWEs frequently affect tropical fruit farming businesses and associated industries. Currently, the government, industries and farmers are applying some adaptation strategies to reduce the adverse effects of extreme events. However, according to the stakeholders that participated in this study, there are a number of options that could improve the existing adaptation strategies, with increasing functional collaboration among state government, local government, farmers and associated industries being particularly emphasised.

5. CONCLUSION & FUTURE RESEARCH

This paper identified the impacts and adaptation strategies of EWEs on fruit farming businesses in sub-tropical Queensland through an analysis of key stakeholders' perceptions regarding these issues as well as further compared with farmers' perceptions which were collected from the farmers' survey. In-depth interviews were conducted with nine key stakeholders from fruit farming industry representatives, financial insurance representatives, stock & station agents, agri-academics, and local and state government employees. A thematic content analysis was performed then the findings of the thematic content analysis have been further discussed by narrative analysis to analyse the interview dataset. The results showed that, among all EWEs,

floods, cyclones, heatwaves, drought and fire events are affecting the fruit farming businesses. To minimise these impacts, some adaptation strategies such as training and assistance for impact management and some industry level supports have already been practiced by the farmers and industries. Government entities have also provided some training assistance and disaster relief in the form of financial aid. However, further strategic planning and functional collaborations are needed amongst the state government, local government, farmers and associated industries. Besides that, the most important adaptation option for farmers is to be self-prepared to enable a rapid and effective response to future EWEs. The key knowledge gathered from this study will not only be helpful for fruit farming businesses but will also be informative for the overall agribusiness in Australia. The further investigation is needed to identify the natures of strategic planning and functional collaborations pattern amongst the state government, local government, farmers and associated industries, which will be helpful for farming businesses in terms of adaptation strategies.

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Technological Innovation in Aquaculture Supply Chain: An Emerging Field of Business for Northern Australia

Nur Hassan, Delwar Akbar, John Rolfe

Central Queensland University

Email: n.hassan@cqu.edu.au.

ABSTRACT

Aquaculture has been experiencing rapid growth over the last decade both in Australia and overseas. Australia is not self-sufficient in sea food demand and imports about half of domestic consumption from overseas. Aquaculture development is highly dependent on advanced technologies and sophisticated management of the supply chain systems. This paper aims to analyze the different technological innovations required for aquaculture development in northern Australia through some examples from north and far north Queensland. This study found that most technologies are available for large scale aquaculture development but there is scope of further technological innovations for small and medium scale aquaculture farmers in north and far north Queensland.

Keywords: Small scale aquaculture development, supply chain, north and far north Queensland

1. INTRODUCTION

The term aquaculture generally refers to the farming of aquatic organisms in controlled aquatic environments for the purpose of food production. It is one of the fastest growing food production systems in the world as it is extensively used as an efficient way to meet the seafood demands of the world population.

Significant growth in aquaculture has occurred over the last decade. Continuous innovation of aquaculture production and market systems (Joffre et al., 2017) have contributed to achieve increase in production for current and future consumers. This involves expansion of production areas (Oyinlola et al., 2018), intensification of production systems (Joffre et al., 2017), adoption of new technologies, and systematic improvement of existing technologies that increased control over husbandry, production processes and biosecurity (Kumar and Engle 2016; Henriksson et al., 2018; Kumar et al., 2018, Obiero et al., 2019).

Globally, total production for wild capture fisheries has remain unchanged for nearly ten years (FAO, 2014). Conversely, aquaculture production, particularly in Asia, has increased quickly in the same period.

Aquaculture produces about half of the seafood consumed by the world population. FAO (2019) estimated that the worldwide production of fish, crustaceans, molluscs and other aquatic animals reached 172.6 million tonnes in 2017, this was an increase of 4.1 % compared with 2016. The capture production was 92.5 million tonnes, which was an increase of 3.5%

compared with the previous year. On the other hand, aquaculture production was 80.1 million tonnes in 2017, an increase of 4.9 % from the previous year. In 2017, the sale value of total production was estimated at USD 383 billion, of which USD 238 billion was from aquaculture production (FAO, 2019).

Recently, Arvin et al. (2018) evaluated the suitability of land in northern Australia for freshwater aquaculture, providing a thorough assessment of marine aquaculture for the Fitzroy, Darwin and Mitchell catchments. The Mitchell catchments is shown in Figure 1. This report (Arvin et al., 2018) presented current aquaculture production and practices in Australia for different species and industries, focusing on potential land-based systems and tropical species suitable for aquaculture in northern Australia. Northern Australia has advantages in terms of aquaculture development, due to its unused available land and water facilities, and a climate characterised by high air temperatures, which is favourable for culturing most tropical aquatic species (Arvin et al., 2018). Previous studies also reported that the substantial opportunity for marine land-based aquaculture along Australia's northern coastline (CSIRO, 2014; McLeod et al., 2002).
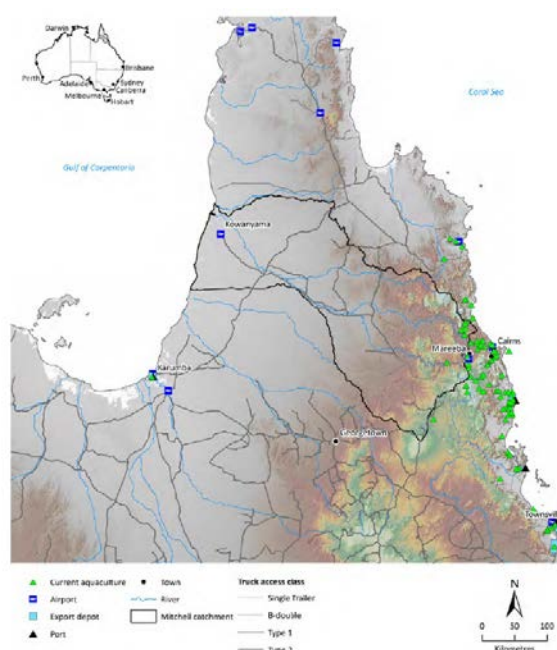

Figure 1: Mitchell catchment (north and far north Queensland), showing location of current aquaculture operations, airports, ports and truck access in Northern Australia (adapted from Arvin et al., 2018, pp. 18).

Three species are identified in the report (Arvin et al., 2018) with the black tiger prawn (*Penaeus monodon*) and barramundi (*Lates calcarifer*) suitable for land-based aquaculture and the red claw crayfish (*Cherax quadricarinatus*) suitable for freshwater pond-based aquaculture in northern Australia. All three species have well suited to land-based aquaculture in the marine and freshwater environments of northern Australia.

Considering the domestic and global demand for fish and other aquatic animals, there is an opportunity to develop aquaculture industries in northern Australia. However, despite these opportunities, the development of aquaculture in northern Australia will face challenges from Asian imported products and monitoring barriers and will also face some risks such as potential chemical toxicants present in the water, and pathogen and disease risks that may be present in this region. Future aquaculture development in northern Australia is emerging but it requires

technological innovation and adoption along the entire supply chain. This study explores the potential for technological innovation and adoption in aquaculture farming as well as supply chain development that is suited for northern Australia.

Section 1 forms the introduction of this paper. Section 2 describes the major aquaculture producing countries in the world. Section 3 discusses the technology innovation framework followed by methods considered for this paper in Section 4. Section 5 illustrates the technology innovations in the aquaculture production and the supply chain areas at global context with some examples and implications for north and far north Queensland. This paper concludes in Section 6 with some recommendations for future study.

2. MAJOR ACQUACULTURE PRODUCING AND CONSUMING COUNTRIES

China is the lead nation for fish production followed by Indonesia, India, the United States of America, and the Russian Federation (FAO, 2019). In the category of the main captured species, Anchoveta was the most caught species followed by Alaska pollock, Skipjack tuna, Atlantic herring, blue whiting and Pacific chub mackerel. The FAO (2019) worldwide capture database revealed that 2,144 species were harvested in 2017, however, the top 30 major species and genera signified almost 54 % of the total capture fisheries production.

Fisheries production in inland waters reached 11.9 million tonnes in 2017, however, the total capture production remains below 13% globally. The top ten aquaculture producer countries, as seen in Table 1, jointly produced 71.2 million tonnes by quantity, contributing 88.9 % to worldwide fisheries production. According to the FAO (2019) report, the combined total production of aquatic animals from capture and aquaculture has risen gradually from 25.7% in 2000 to 46.4% in 2017 (FAO, 2019). However, as a large country like Australia has a greater opportunity to evolve further in this area.

Table 1: The top ten aquaculture producing countries 2017*

Ranking	Country	Amount produced
1	China	46.8 million tonnes
2	India	6.2 million tonnes
3	Indonesia	6.2 million tonnes
4	Viet Nam	3.8 million tonnes
5	Bangladesh	2.3 million tonnes
6	Egypt	1.5 million tonnes
7	Norway	1.3 million tonnes
8	Chile	1.2 million tonnes
9	Myanmar	1 million tonnes
10	Thailand	1 million tonnes

Source: FAO
*Note: exclude aquatic plants and non-food products

In Australia, aquaculture operations are regulated by local, state/territory and Australian governments (Department of Agriculture, 2015). Demand for sustainably sourced seafood has increased over the last three decades (Department of Agriculture, 2015). It is likely that domestic aquaculture in Australia has the capability of expanding significantly to meet the growing demand for seafood both nationally and internationally. The Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES) specified in their report (Department of Agriculture, 2015) that the volume of aquaculture production has increased strongly in Australia around 11 % annually over the 20 years until 2011–12 and it almost doubled over the period 2003–04 to 2013–14, compared to the substantial decline in the wild-catch sector. In 2012–13, aquaculture was responsible for producing around 43% of the gross value of Australia's (GVA) fisheries production, and it was worth approximately $1 billion. In comparison with the word market, Australia's aquaculture industry is comparatively small, responsible for less than 1% of the projected worth of US$138 billion of aquaculture production in 2012. However, Australia's strength is in producing safe, sustainable, high quality and high-value products such as oysters, salmon, tuna and prawns (FAO, 2014; Department of Agriculture, 2015).

The United States of America is a major consumer of aquaculture products. The U.S. imports 84% of the seafood, and 50% of that is coming from aquaculture, although, the U.S. is not a big producer of aquaculture products (NOAA, 2011). The U.S. aquaculture both freshwater and sea supplies about 5% of the U.S. seafood supply, and the U.S. marine aquaculture supplies less than 1.5 % of population needs (NOAA, 2011). However, the U.S. is trying to develop its own aquaculture industry in a sustainable way, which can reduce its annual $9 billion annual seafood import shortfall (NOAA, 2011).

3. TECHNOLOGY INNOVATION FRAMEWORK

3.1 Drivers of innovation

According to FAO (2019), the aquaculture production reached $232 billion in first-value sales in 2016, which is responsible for a growth of $100 billion from 2010 in north America. It can grow by another $100 billion in less than a decade through modernization and professionalization of aquaculture if three key challenges are addressed in genetics, new husbandry technologies, and innovations in aquafeed (FAO, 2019). The switching to more technology-driven and efficient intensive farming technologies were key to boosting production in recent years in North America (Liza Mayer, 2018).

Therefore, it is essential to change to advanced technology-driven and efficient intensive farming technologies that should allow farmers to increase production quickly. The important three key factors such as improved genetics, new husbandry technologies, and innovations in aquafeed are required to increase the production.

Northern Australia is the hub for some of Australia's biggest aquaculture industries such as farmed prawns, barramundi, pearls and crayfish, which jointly responsible for producing $300 million of aquaculture product yearly (Department of Agriculture, 2015). This region is now becoming a promising choice to be the hub of aquaculture in Australia. Furthermore, the Northern Queensland aquaculture industries emphasis on clean, safe and high-quality product which placed this region to be a global leader in this industry (Department of Agriculture, 2015).

Queensland's aquaculture industry attracts overseas investors as it produces high-quality seafood. Recently, Minister for Agricultural Industry Development and Fisheries in 2019 announced interested investors and local councils would now be able to easily identify suitable

potential locations for projects and mentioned the Queensland Government supports the future.

3.2 Constraints of innovation

Most recently in 2019, FAO indicated in International Symposium on Fisheries Sustainability to identify pathways to strengthen the science and policy interaction in fisheries production, management and trade for improving the worldwide outcomes. In this symposium, FAO predicted that the fisheries and aquaculture sectors can only be achieved the maximum benefits by wisely balancing environmental, social and economic sustainability principles in the management of the natural aquatic resources.

Aquaculture farming organizations are influenced by risks and uncertainty or other limitations, which are inherent to aquaculture production. The Queensland, especially northern Queensland is prone to flood and cyclone that affects many aquaculture operations. Potential business owners should understand the Queensland's weather that could affect their business. Business owners could be experiencing some sort of limitations and risks that include (Business Guide - Queensland Government, 2019):

    i.   Establishment and management risks

    ii.   Biological requirements of aquaculture species

    iii. The physical environment in which the farm operates

    iv.   Current and future markets.

Other socioeconomic, environmental, technological and institutional constraints are also affecting aquaculture development. Moreover, social and economic aspects of aquaculture have received much less attention than production aspects (Ruddle 1993; Harrison et al.,1994). The inadequate supply of required species, the high cost of fish pond establishment and the lack of awareness of available innovations are also issue for developing aquaculture business. Some production related factors could also be limiting aquaculture production. Therefore, inadequate production, market variability and lack of technological innovation and affordable technology are the main obstacles for developing a sustainable aquaculture supply chain.

3.3 Technology adoption

Aquaculture technologies have progressed quickly in recent years (Shava and Gunhidziral, 2017). The adoption of the technology has played an important role in the worldwide development in aquaculture products (Kumar et al., 2018). However, implementing new technology in any organizations is very cumbersome.

Most of farmers have been inclined to implement technologies that offer advantages in productivity, cost efficiency, and ease of management. Farmers are always considering the economic factors such as the price of aquaculture products and what profit margins they receive when they have adopted a new technology. Therefore, careful attention has been paid to drivers of technology adoption in aquaculture. The scope of adoption of technologies totally depend on the nature of the industry in which they are adopted and their economic, social, political, and regulatory environments (Kumar et al., 2018). Some of the critical factors that influence aquaculture technology adoption include:

    i.   Method of information transfer,

    ii.   Characteristics of the technology,

    iii. Farm characteristics,

    iv.   Economic factors, and

    v.   Sociodemographic and institutional factors.

4. METHODS AND MATERIALS

The study followed an exploratory research approach through a systematic literature review on aquaculture supply and demand, drivers and constraints of technological innovation and adoption in the aquaculture supply chain. This study also used secondary data and information from Australian and international sources such as FAO.

The systematic literature review helps to define the themes to review based on the findings from the secondary data and published research findings (Cordeiro, 2019). Therefore, this study reviews the evidence and information that already had been generated by previous studies. As there is limited published research findings on aquaculture supply chain development in the northern Australia context, this study included scholarly articles as well as industry and government reports. In addition, the study also used some grey literature from local newspapers.

5. TECHNOLOGICAL DEVELOPMENT IN AQUACULTURE

This section describes the technological development in the aquaculture supply chain with some examples and implications for north and far north Queensland.

5.1 Dimensions

Aquaculture faces many challenges particularly, combating diseases and epizootics, brood-stock improvement and domestication, development of proper feeds and feeding mechanisms, hatchery and grow-out technology, and water-quality management (Subasinghe et al., 2003). Choosing the most appropriate production system is an important phase when launching or expanding an aquaculture business. According to the Queensland Government (Business Queensland, 2016), sea ranching, surface lines, subsurface lines, racks, sea cage culture, land-based marine ponds and tanks and hatcheries are suitable production systems for marine environments, on the other hand, fresh water pond and tank systems are suitable for freshwater environments. Production systems will vary according to their set-up and the species they are appropriate for.

Recently, Helmstetter (2019), an entrepreneur presented 5 innovations in aquaculture industries are important to be implemented and those are disease prevention, oral delivery of vaccines, fish meal replacement, aquaculture sustainability, and block chain (digital record of transactions) in aquaculture. Focusing on global trends in aquaculture production, local producers can adopt newer technologies and can differentiate which technology make an impact on their productivity.

In Queensland, every aquaculture owner should follow the health management technical guidelines for disease management. All samples or species should be collected from disease-free sources only, after suitable health testing and disease-free authorization by an authentic veterinary laboratory and disinfect eggs or larvae where appropriate. The interstate movement of aquatic animals is not allowed under the self-assessable code.

Environmental consequences of poorer management system in aquaculture are now starting to be understood. Some of the key environmental factors are to be considered for wellbeing of fishes are as follows (Greenberg, 2014):

I.   Forage fish impacts

II.   Pollution

III.   Habitat destruction

IV.   Escapes

V.   Disease transfer

5.2 Supply Chain

In supply chains, two process are very important, those are managing export and local supply chains. A typical supply chain flow chart for aquaculture is shown in Figure 2 where factor markets lie at the very top, then the production, the intermediary and consumption markets. Institutional support for research and development and regulation of environmental, health and ethical issues is linked to each level of the chain (Ankamah-Yeboah et al., 2017).
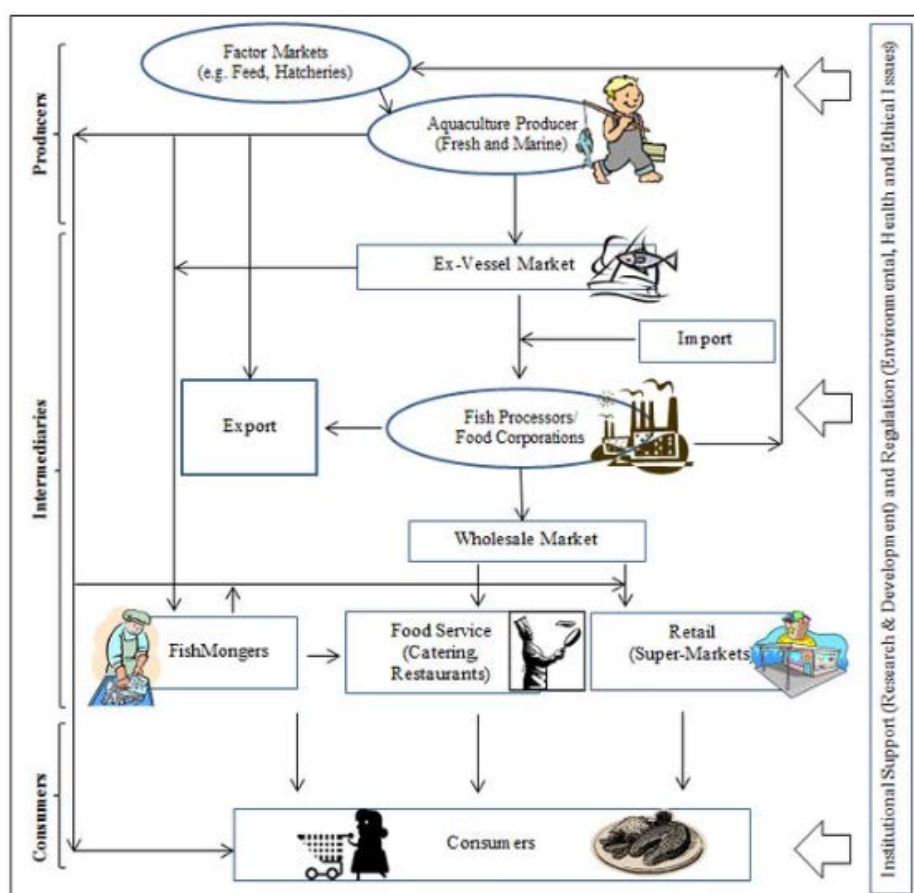

Figure 2: Aquaculture supply chain (adapted from Nielsen, 2000, pp.1-72)

Marchante et al., (2014) presented an innovative traceability system architecture based on web services, through Radio Frequency Identification (RFID) systems with relevant environmental data collected with Wireless Sensor Networks (WSN) infrastructure as shown in Figure 3. The system is suitable to be employed in Small to Medium Business (SMEs) to improve traceability in the aquaculture sector. This system is worked by integrating information collected along the entire supply chain, tracking the products from the company to the consumer. The system integrates different technologies and standards for monitoring the environment for the first time. This technology was used successfully in aquaculture companies in Slovenia and Spain. For instances, a medium sized aquaculture company named Culmárex in Spain, which breeds

sea bream and sea bass has used traceability system-based technology in their aquaculture supply chain (Marchante et al., 2014).
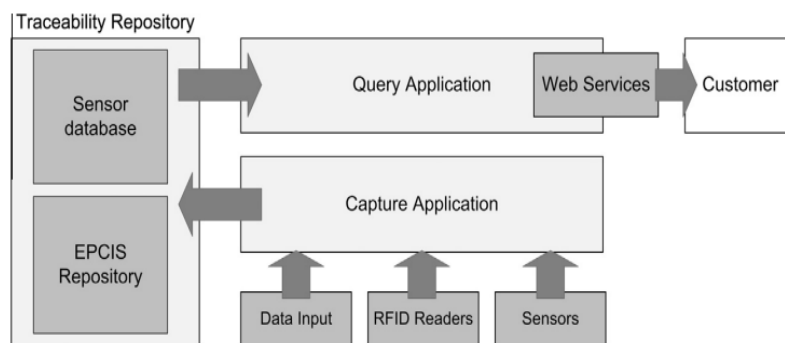

Figure 3: Architecture of the traceability system based on the network architecture that uses RFID and WSN technologies to collect information (adapted from Marchante et al., 2014, pp. 99-109).

5.3 Technological innovations in aquaculture

In aquaculture industries, the use of net cages was started first in the 1800s in the Southeast Asia region (Gopakumar, 2009). This type of cage was positioned in enclosed basins, in closed coves and gulfs at sea, and lakes in fresh waters in the early days. However, the next generation cages are at the design stage. A circular structure formed by joining triangular net parts is known as Aquapod (InnovaSea Systems, 2017) which is surrounded by nets and usually floats on the sea. It was started to be used in 2011 and is very suitable for aquaculture in open sea.

A Barcelona-based Forward-Thinking Architecture company has designed a floating farm or smart floating farm, that well operate autonomously as they float on the open sea (Smart farm, 2015). This farm uses a new innovative system where solar panels are used on the top floor which meets the energy needs, vegetable production is in the mid-level and pools and aquaculture fish and other species production are placed in the lower level. With the Aquaponic production, the wastewater from the fish ponds is used in vegetable production, while the vegetable products can be used in feeding the fish.

Aquaponics is an eco-innovative technology which combines the aquaculture and hydroponics (growing plants in water without soil) (Thorarinsdottir, 2015). It is a resource efficient closed loop food production system where water is kept in circulation. Waste water from the fish is used as nutrients in the gardening part of the system where plants take up the nutrients provided by the fish waste and clean the water before being returned to the fish.

Again, a Recirculation Aquaculture System (Bregnballe, 2010) is a traditional method where the water is treated continuously to remove the waste products excreted by the fish, and oxygen is added to keep the fish alive. Water is flowing to a mechanical filter from the outlet of the fish tanks and further on to a biological filter before it is aerated and stripped of carbon dioxide and returned to the fish tanks.

The land-based closed recirculating aquaculture system (RAS) is an FRD Japan's aquaculture system which treats the water using bacteria, making it possible to farm fish in a completely closed water recirculating system using artificial seawater made from a municipal water supply (FRD-Japan, 2018).

Two influential factors namely the feed cost and the water/land availability are essential for aquaculture business. The feed cost is responsible for 60% of the total production cost in an aquaculture and sometimes, it is very hard to find the available land and water for production

of aquatic animals[1]. High stocking density and rearing of aquatic animals requires wastewater treatment. Biofloc system[1] is a wastewater treatment which has gained importance as a cost-effective process in aquaculture. The principle of this technique is to generate a higher Carbon: Nitrogen ratio through circulating heterotrophic microbial growth, which integrates the nitrogenous waste that can be exploited by the cultured spices as a feed. The biofloc technology is not only effective in treating the waste but also provides nutrition to the aquatic animal.

The use of recirculating aquaculture systems in aquaculture reduces environmental impacts to a minimum level. The application of environmentally friendly production methods such as Biofloc system is a user friendly and a cost-effective process. It could easily be implemented in the Northern Queensland environment to minimize the environmental effect while achieving maximum productivity in aquaculture industry.

6. CONCLUTIONS AND FUTURE RECOMENDATIONS

Aquaculture is a relatively new industry in Queensland as well as in northern Australia, particularly for north and far north Queensland. Aquaculture businesses face challenges to integrate the modern technological developments to increase environmentally friendly production. Newer technologies are reviewed in this study to identify suitable technologies for northern Australia. Most technologies are expensive to adopt for small and medium scale farmers so there is scope for future study to develop affordable technology for such farmers.

To create sustainable aquaculture production in north and far north Queensland and even in the wider northern Australia, it is necessary to develop supply chains with domestic and international markets. Digital aquaculture is in an initial stage in Australia although Australia is behind in this area compared to other developed nations. The innovation in supply chain system incorporates data management policies. Data analysis, digital literacy and decision support tools are crucial to adopt to enhance the aquaculture supply chain system. Therefore, further investigation is recommended to integrate digital based technology into the supply chain system.

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Comparing the Household Solar System Installation Patterns Between Brisbane Metropolitan Region and Regional Queensland

Md Rahat Hossain & Delwar Akbar

Central Queensland University,

Email: m.hossain@cqu.edu.au

ABSTRACT

More than 30 percent of Queensland houses have rooftop solar system (photovoltaic i.e., PV). However, it is yet to know the factors affecting the solar power installations between Brisbane Metropolitan region and regional Queensland' residents. This study examines the PV installations trend and patterns between Brisbane Metropolitan region and regional Queensland. The study also identifies key factors affecting the variation of PV installations between metropolitan and regional households. A quantitative methodology supported by secondary data and autoregressive integrated moving average (ARIMA) model has been adopted in this study. This study predicted that PV installations in the Brisbane metropolitan area would be increased after 2020. On the other hand, PV installations in regional Queensland is on the peak now and it would decline in 2020 and then a regular trend would appear. In addition, the study found a positive relationship between PV installations and the separate houses with three or more bedrooms. Therefore, these findings can help in future PV expansion planning in Queensland.

Key Words: PV Systems, ARIMA model, socio-demographic factors, metropolitan and regional Australia

1. INTRODUCTION

Queensland is the second largest state in Australia, and it is located in the tropical and sub-tropical zones in the southern hemisphere. This locational advantage makes Queensland as a solar energy powerhouse. About half a million Queensland's homes have a solar system installed (Lynham, 2018). More than 640,970 small scale systems (i.e. <100kW) had been installed across the state (Clean Energy Regulator, 2019). Queensland Government expects this figure to rise to about one million homes by 2020. On the other hand, commercial scale PV system installations have been growing in Queensland too. The Queensland Government has set a goal of 50 per cent renewable energy generation capacity by 2030 and solar energy plays an important role in this target (O'Neill, 2019). Small scale PV systems installed across Queensland collectively represent more than 2.58GW of capacity. Approximately 514 watts of solar power capacity installed per capita in Queensland where Australia's average is about 392 watts/capita (ABS, 2016a). While solar uptake in Queensland has slowed down since the Solar Bonus Scheme closed in 2012, many households are considering to install solar panels. Some Brisbane suburbs already having a solar penetration of more than 50% houses (Australian

Energy Council, 2016). Recently many regional Queensland households have started installing 6kW+ capacity solar system (Australian Energy Council, 2019). So, it is important to understand the trend and installation pattern of PV installations between Brisbane metropolitan region and the regional Queensland in order to expanding the renewable energy initiatives taken by both state and the federal government. Therefore, this study aims to examine the residential PV installations trend and patterns between Brisbane Metropolitan region and regional Queensland, and identify the key factors affecting the PV system installations by the metropolitan and regional households, based on secondary data modelling and interpretation.

This paper is organised as follow. This introduction section forms Section 1 of the paper. Section 2 provides literature review on identification of theories and potential factors affecting household decision towards PV installation. Section 3 describes the data and methods used in this paper. Section 4 describes the findings and analysis, and the paper concludes conclusion in Section 5.

2. THEORY AND CONTEXT OF PV INSTALLATIONS

Many factors such as sociodemographic, economic and dwelling characteristics are influencing the household decision towards PV installation at the own home (Bashiri and Alizadeh, 2018). There is no particular theory that can define the reasons behind the household decision to install PV system. However social cognitive domain-based theories such as theory of planned behaviour, theory of reasoned action and transaction cost theories have been used to understand the household choice to install PV system (Bashiri and Alizadeh, 2018; Qureshi et al, 2017; Cleland et al, 2015).

Australian households usually install PV system to reduce their electricity bills, manage the risk of future electricity price rises, and increase self-sufficiency (McHugh, 2018). Karuppanna and Han (2013) conducted a survey on Adelaide and Melbourne households to understand the factors affecting household energy consumption. They found the low-income families were more likely not to use PV or any other renewable sources of electricity compared to high income families. Low income families also have less capacity to pay for energy savings electric appliances. Roberts et al (2018) found multi-occupancy buildings or semi-detached dwellings have lower proportion of PV installations compared to detached houses or buildings in Australia. This study developed a model to estimate roof top solar potential. Qureshi et al (2017) also found the household's financial capacity to install PV is one of the most important determinants in a metropolitan city of Pakistan. Therefore, household financial capacity of urban residents across developed and developing countries play important role in PV installation in the residential houses.

The above studies either explore socio-economic factors affecting metropolitan cities' household's decision towards PV system installation or assessing roof top solar capacity of the urban dwellings but did not explore the differences between installation trend between urban and regional Australia or did not examine the nature of dwelling ownership and number of bed rooms in a dwelling unit that can affect the household decision to install PV system. This study fills this gap by examining the variation in PV installation between metropolitan region and non-metropolitan (rural and regional area) in Australia as well as explaining role of dwelling ownership and dwelling size (by number of bedrooms) in Brisbane Metropolitan region and regional Queensland.

3. METHODS AND MATERIALS

A quantitative methodology supported by secondary data and autoregressive integrated moving average (ARIMA) model has been adopted in this study. Per-month solar installations time series data of Metropolitan Brisbane region and regional Queensland by selected postcodes since January 2007 to June 2019 were collected from Australian PV Institute (APVI, 2019a). For this paper, house ownership percentage, median weekly household income, separate house percentage, occupied private dwellings percentage, and 3 or more bedrooms percentage over the last three censuses (2006, 2011 and 2016) were collected from Australian Bureau of Statistics (ABS, 2016b). This study particularly collected data for the Brisbane Metropolitan region to represent metropolitan cities in Queensland and the postcodes of 4710, 4510, 4516, and 4810 to represent the regional Queensland. Solar installations data from Australian PV Institute were available from January 2007 (APVI, 2019b) and census data were taken from 2006. This time gap is one of the delimitations for this study, given the fact that, solar installations were at a minimum level in 2006.

For prediction purpose, this study used time series model by using SPSS software. Autoregressive moving average is a well-recognised time series prediction method to forecast the renewable energy installation (Erdem and Shi, 2010). An ARIMA model is a statistical model used for estimating the temporal dynamics of an individual times series. ARIMA models comprised three parts: (1) an autoregressive (AR) component, (2) an integration (I) component, and (3) a moving average (MA) component (Smith, 2018). An ARIMA model can be used to understand non-seasonal and seasonal variation and trend. A nonseasonal ARIMA model (Nau 2019) is classified as an 'ARIMA(p,d,q)' model, where:

- p is the number of autoregressive terms
- d is the number of nonseasonal differences needed for stationarity and
- q is the number of lagged forecast errors in the prediction equation.

The forecasting equation is built as follows in equations 1-3 (Nau 2019). First, let y denote the dth difference of *Y*, which means:

If *d=0:* $y_t = Yt$ (1)

If *d=1:* $y_t = Yt - Y_{t-1}$ (2)

If *d=2:* $y_t = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) = Yt - 2Y_{t-1} + Y_{t-2}$ (3)

It is to be noted that the second difference of *Y* (the *d=2* case) is not the difference from 2 periods back. Rather, it is the *first-difference-of-the-first difference*, which is the discrete analog of a second derivative.

In terms of *y,* the usual forecasting equation is presented in equation 4 (Nau 2019):

$\hat{y}_t = \mu + \phi_1 y_{t-1} + ... + \phi_p y_{t-p} - \theta_1 e_{t-1} - ... - \theta_q e_{t-q}$ (4)

Seasonal autoregressive, moving average, and differencing components play the same roles as their nonseasonal counterparts. However, for seasonal orders, existing series values are impacted by previous series values separated by one or more seasonal periods.

Equation for a seasonal *ARMA(p,q)(P,Q)* model (equation 5):

$$y_t = C + \sum_{i=1}^{p} \varphi_i y_{t-i} + \sum_{i=1}^{P} \Phi_i y_{t-is} + \varepsilon_t - \sum_{i=1}^{q} \theta_i \varepsilon_{t-i} + \sum_{i=1}^{Q} \Theta_i \varepsilon_{t-is} \qquad (5)$$

Where {y_t}, {φ}, and {θ} are as defined previously, and {Φ} and {Θ} are the seasonal counterparts (Box, G, Jenkins, G and Reinsel, C, 2008).

To test for lack of fit of the time series model, the Box-Ljung Test (Ljung, G and Box, G 1978) diagnostic tool was used. The test is applied to the residuals of a time series after fitting an *ARMA(p,q)* model to the data. The test examines *m* autocorrelations of the residuals. If the autocorrelations become very small, it can be concluded that the model does not show significant lack of fit.

In general, the Box-Ljung test is defined as:

H₀: The model does not exhibit lack of fit.

Hₐ: The model exhibits lack of fit.

Given a time series *Y* of length *n*, the test statistic is defined as (equation 6):

$$Q = n(n+2) \sum_{k=1}^{m} \frac{\hat{r}_k^2}{n-k} \qquad (6)$$

where $\hat{r}_k$ is the estimated autocorrelation of the series at lag *k*, and m is the number of lags being tested (Smith, 2018).

Solar installations were converted to solar installations per capita to eliminate the biasness of data. Solar installations per capita were then compared with house ownership percentage, median weekly household income, separate house percentage, occupied private dwellings percentage, and 3 or more bedrooms percentage to produce comparative column charts.

4. FINDINGS AND ANALYSIS

Overall fit of the model

For Brisbane metropolitan region, the following predicted solar installations trend (Figure 1) and values (Table 1-3) have been found. According to the achieved results from SPSS forecasting, the best fit model is the non-seasonal ARIMA (0,1,1) (0,0,0). Here, Stationary R-squared is 0.468 and Ljung-Box Q is .487, which indicate a good fit of the model because higher the Stationary R-squared and higher the Ljung-Box Q values the better the model fit (Bakker 2012). Here, the Ljung-Box Q = .487, which is greater than 0.05 and hence we fail to reject the null hypothesis i.e. we fail to reject that the model does not exhibit lack of fit.
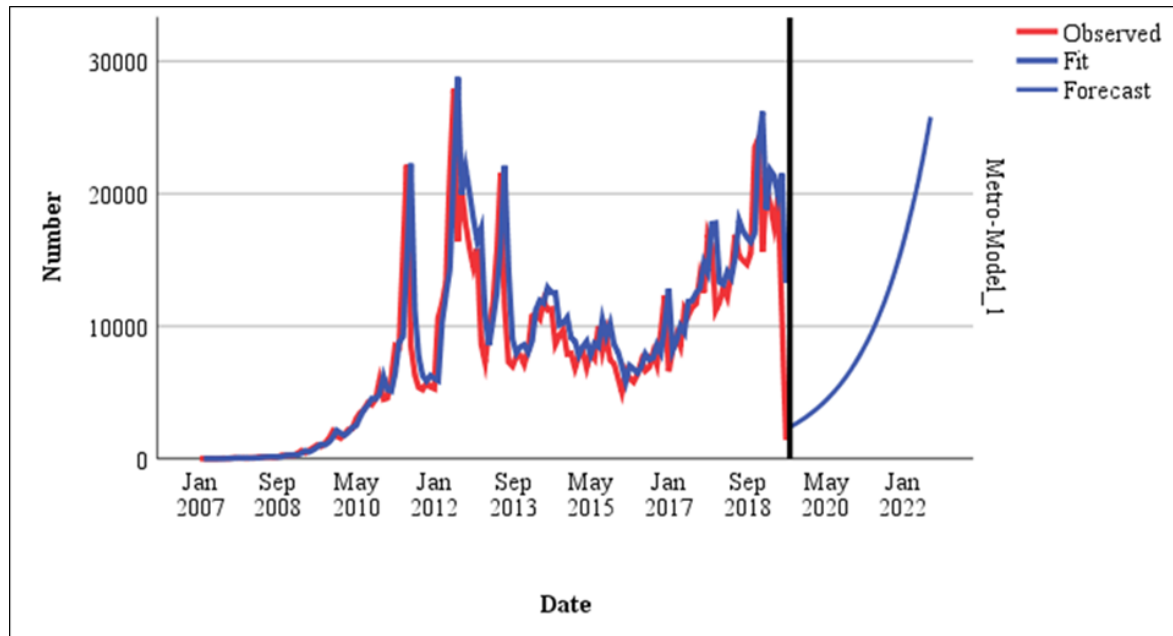
Table 1: Model description

			Model Type
Model ID	Metro	Model_1	ARIMA(0,1,1) (0,0,0)

Table 2: Model summary

Model Fit											
					Percentile						
Fit Statistic	Mean	SE	Minimum	Maximum	5	10	25	50	75	90	95
Stationary R-squared	.468	-	.468	.468	.468	.468	.468	.468	.468	.468	.468
R-squared	.728	-	.728	.728	.728	.728	.728	.728	.728	.728	.728
RMSE	3274.362	-	3274.362	3274.362	3274.362	3274.362	3274.362	3274.362	3274.362	3274.362	3274.362
MAPE	36.122	-	36.122	36.122	36.122	36.122	36.122	36.122	36.122	36.122	36.122
MaxPE	839.842	-	839.842	839.842	839.842	839.842	839.842	839.842	839.842	839.842	839.842
MAE	1828.513	-	1828.513	1828.513	1828.513	1828.513	1828.513	1828.513	1828.513	1828.513	1828.513
MaxAE	13743.921	-	13743.921	13743.921	13743.921	13743.921	13743.921	13743.921	13743.921	13743.921	13743.921
Normalized BIC	16.221	-	16.221	16.221	16.221	16.221	16.221	16.221	16.221	16.221	16.221

Table 3: Model statistics

Model	Model Fit Statistics			Ljung-Box Q(18)			
	Number of Predictors	Stationary R-squared	Normalized BIC	Statistics	DF	Sig.	Number of Outliers
Metro-Model_1	0	.468	16.221	16.527	17	.487	0

Figure 1: Solar installation forecasting in Brisbane metropolitan region

For the regional QLD, the following predicted solar installations trend (Figure 2) and values (Table 4-6) have been found. According to the results the best fit model is the non-seasonal ARIMA (0,1,4) (0,0,0) Exponential Smoothing. Stationary R-squared = 0.448 and Ljung-Box Q = .179 that indicates a good fit of the model as higher the Stationary R-squared and higher the Ljung-Box Q values the better the model fit. Here, the Ljung-Box Q = .179 which is greater than 0.05 and hence we fail to reject the null hypothesis i.e. we fail to reject that the model does not exhibit lack of fit.
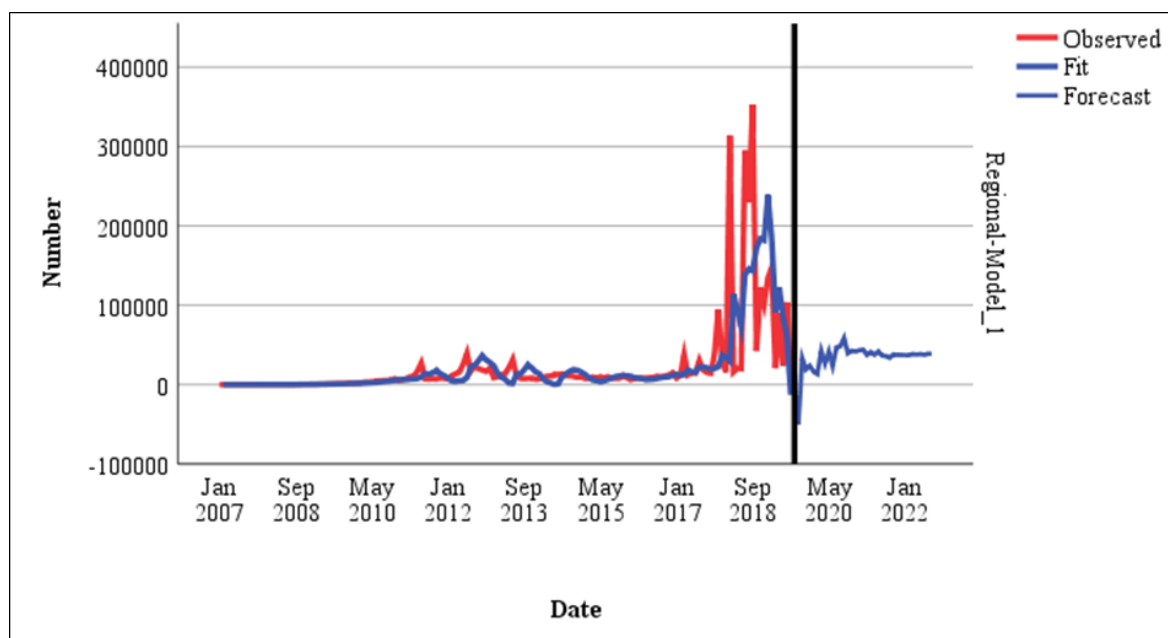
Table 4: Model description

			Model Type
Model ID	Regional	Model_1	ARIMA(0,1,4) (0,0,0)

Table 5: Model summary

Fit Statistic	Model Fit										
					Percentile						
	Mean	SE	Minimum	Maximum	5	10	25	50	75	90	95
Stationary R-squared	.448	-	.448	.448	.448	.448	.448	.448	.448	.448	.448
R-squared	.414	-	.414	.414	.414	.414	.414	.414	.414	.414	.414
RMSE	40217.741	-	40217.741	40217.741	40217.741	40217.741	40217.741	40217.741	40217.741	40217.741	40217.741
MAPE	69.302	-	69.302	69.302	69.302	69.302	69.302	69.302	69.302	69.302	69.302
MaxPE	1500.799	-	1500.799	1500.799	1500.799	1500.799	1500.799	1500.799	1500.799	1500.799	1500.799
MAE	15123.344	-	15123.344	15123.344	15123.344	15123.344	15123.344	15123.344	15123.344	15123.344	15123.344
MaxAE	28444.355	-	28444.355	28444.355	28444.355	28444.355	28444.355	28444.355	28444.355	28444.355	28444.355
Normalized BIC	21.304	-	21.304	21.304	21.304	21.304	21.304	21.304	21.304	21.304	21.304

Table 6: Model statistics

	Model Fit Statistics			Ljung-Box Q(18)			
Model	Number of Predictors	Stationary R-squared	Normalized BIC	Statistics	DF	Sig.	Number of Outliers
Regional-Model_1	0	.448	21.304	19.813	15	.179	0

Figure 2: Solar installation forecasting in regional Queensland

2-D column chart in Figure 3 is based on the data presented in Table TA1 (Appendix 1). Figure 3 demonstrates that the patterns between solar installations per capita and house ownership of metropolitan and regional QLD. However, the pattern is unable to identify any significant relationship or dependency between house ownership and solar installations per capita either in metropolitan or in regional QLD.

Figure 3: Relationship between solar installations per capita and house ownership of metropolitan and regional QLD

2-D column chart in Figure 4 is based on the data presented in Table TA2 (Appendix). Figure 4 demonstrates the patterns or trends between solar installations per capita and median weekly household income of metropolitan and regional QLD. However, the pattern is unable to identify any significant relationship or dependency between median weekly household income and solar installations per capita either in metropolitan or in regional QLD.
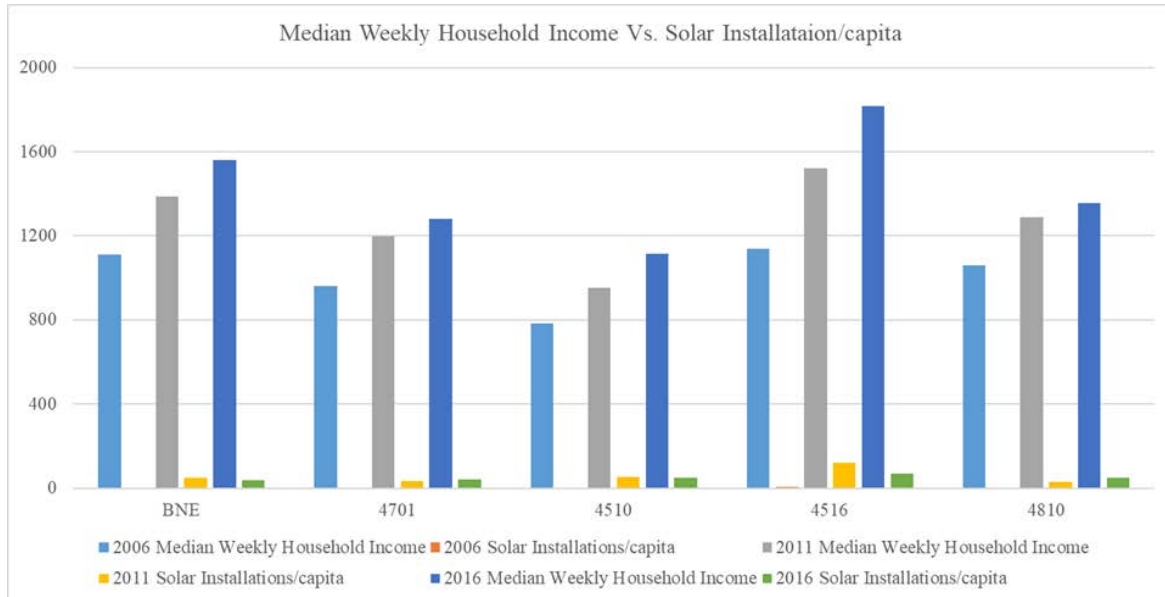

Figure 4: Relationship between solar installations per capita and median weekly household income of metropolitan and regional QLD

2-D column chart in Figure 5 is based on the data presented in Table TA3 (Appendix). Figure 5 demonstrates the patterns or trends between solar installations per capita and separate house of metropolitan and regional QLD. However, the pattern is unable to identify any meaningful relationship or dependency between separate house and solar installations per capita either in metropolitan or in regional QLD.
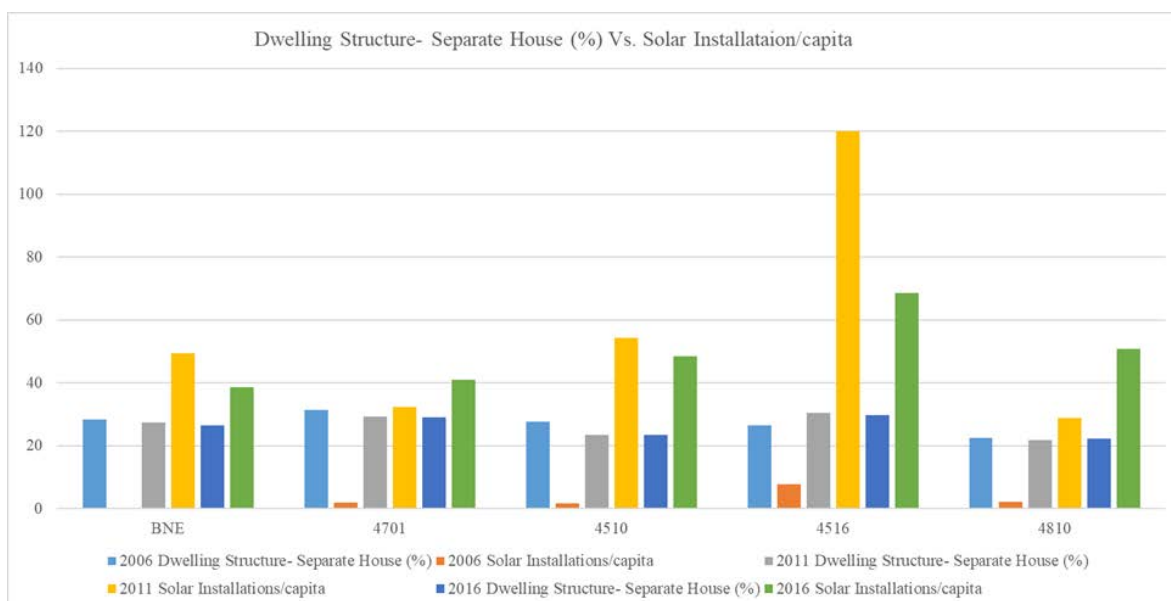

Figure 5: Relationship between solar installations per capita and separate house (%) of metropolitan and regional QLD

2-D column chart in Figure 6 is based on the data presented in Table TA4. Figure 6 demonstrates the patterns or trends between solar installations per capita and occupied private dwellings of metropolitan and regional QLD. However, the pattern is unable to identify any meaningful relationship or dependency between occupied private dwellings and solar installations per capita either in metropolitan or in regional QLD.
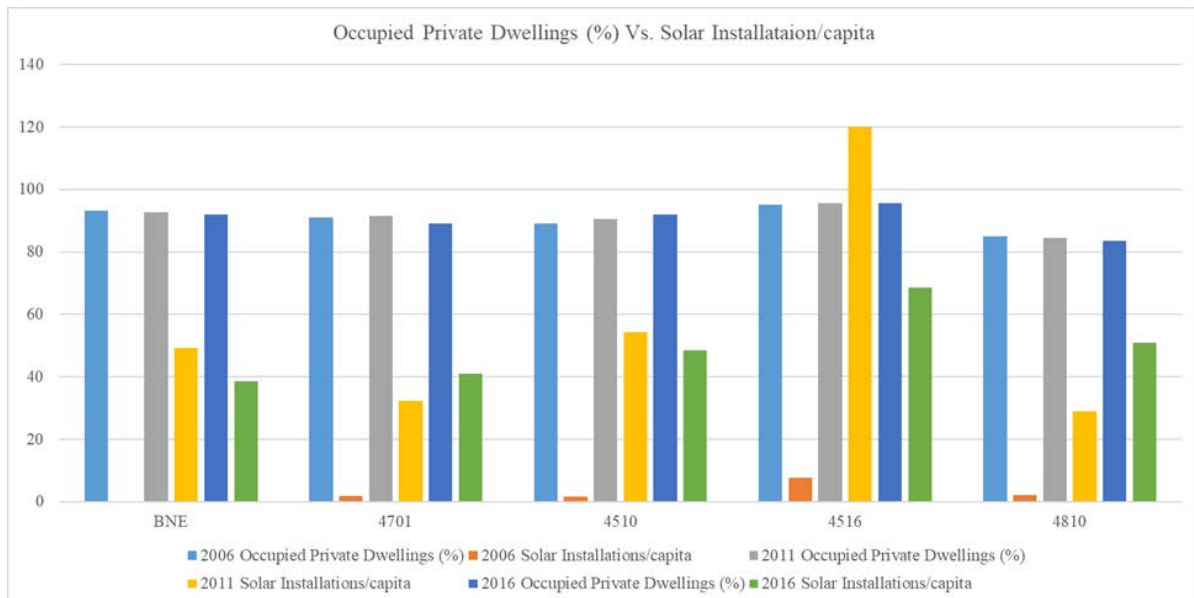

Figure 6: Relationship between solar installations per capita and occupied private dwellings (%) of metropolitan and regional QLD

2-D column chart in Figure 7 is based on the data presented in Table TA5. Figure 7 demonstrates the patterns or trends between solar installations per capita and separate house of 3 or more bedrooms of metropolitan and regional QLD. In this column chart it is quite evident that there is a relationship between those two factors. Considering 2006 data as outlier, 2011 and 2016 data showed a significant relationship of the households occupying 3 or more bedrooms houses with the increase or decrease of solar installations per capita.
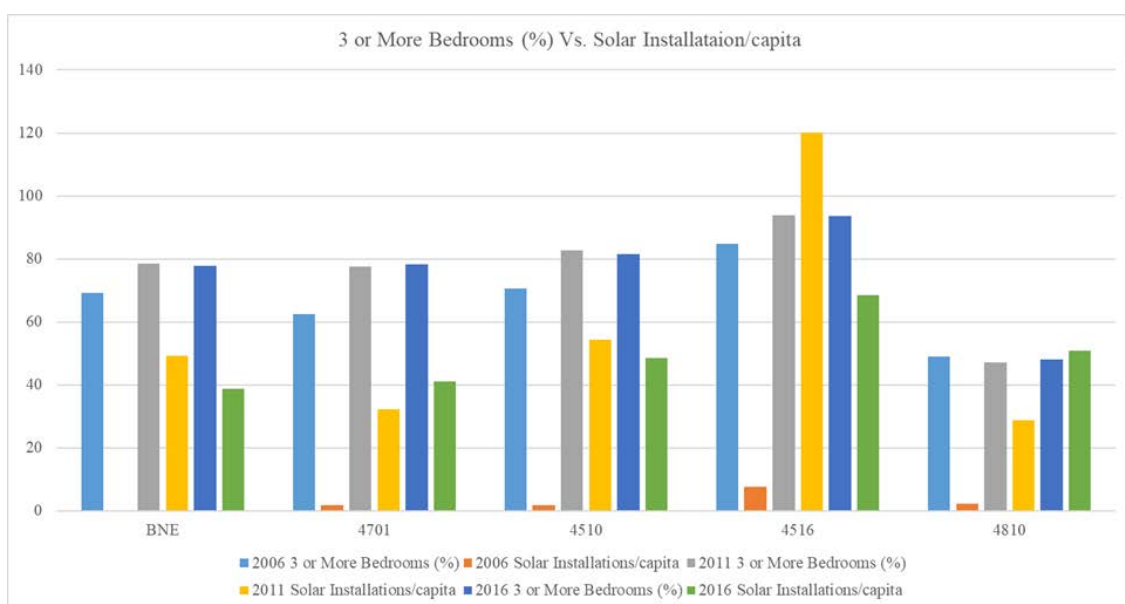

Figure 7: Relationship between solar installations per capita and separate house of 3 or more bedrooms (%) of metropolitan and regional QLD

5. CONCLUSION

This study examined the PV installations trend and patterns between Brisbane Metropolitan region and regional Queensland. This study used ARIMA model to understand the variation of trend and patterns of solar system installations between Brisbane Metropolitan region and regional Queensland. The models did not find a pattern that can identify any significant relationship between solar installations per capita and house ownership, median weekly household income and occupied private dwellings over metropolitan Brisbane and regional Queensland. However, the study found a positive relationship between PV installations and the separate houses with three or more bedrooms. This study predicted that PV installations in the Brisbane metropolitan area would be increased after 2020. On the other hand, PV installations in regional Queensland is on the peak now and it would decline in 2020 and then a regular trend would appear thereafter. Therefore, these findings can help in future PV system expansion planning for residential sector in Queensland.

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APPENDICES

Table TA1: Solar installations per capita and house ownership of metropolitan and regional QLD data.

	2006		2011		2016	
	House Ownership (%)	Solar Installations/ capita	House Ownership (%)	Solar Installations /capita	House Ownership (%)	Solar Installations/ capita
BNE	28.40	0.19	27.30	49.31	26.40	38.65
4701	31.30	1.88	29.30	32.29	29.00	41.02
4510	27.70	1.74	23.40	54.26	23.50	48.53
4516	26.50	7.68	30.40	120.10	29.80	68.63
4810	22.50	2.22	21.90	28.85	22.30	50.88

Table TA2: Solar installations per capita and median weekly household income of metropolitan and regional QLD data.

	2006		2011		2016	
	Median Weekly Household Income	Solar Installations/ capita	Median Weekly Household Income	Solar Installations/ capita	Median Weekly Household Income	Solar Installations/ capita
BNE	1111.00	0.19	1388.00	49.31	1562.00	38.65
4701	960.00	1.88	1198.00	32.29	1282.00	41.02
4510	784.00	1.74	953.00	54.26	1114.00	48.53
4516	1137.00	7.68	1522.00	120.10	1816.00	68.63
4810	1060.00	2.22	1290.00	28.85	1357.00	50.88

Table TA3: Solar installations per capita and separate house of metropolitan and regional QLD data.

	2006		2011		2016	
	Dwelling Structure- Separate House (%)	Solar Installations/ capita	Dwelling Structure- Separate House (%)	Solar Installations/ capita	Dwelling Structure- Separate House (%)	Solar Installations/ capita
BNE	28.40	0.19	27.30	49.31	26.40	38.65
4701	31.30	1.88	29.30	32.29	29.00	41.02
4510	27.70	1.74	23.40	54.26	23.50	48.53
4516	26.50	7.68	30.40	120.10	29.80	68.63
4810	22.50	2.22	21.90	28.85	22.30	50.88

Table TA4: Solar installations per capita and occupied private dwellings of metropolitan and regional QLD data.

	2006		2011		2016	
	Occupied Private Dwellings (%)	Solar Installations /capita	Occupied Private Dwellings (%)	Solar Installations/ capita	Occupied Private Dwellings (%)	Solar Installations/ capita
BNE	93.10	0.19	92.70	49.31	92.00	38.65
4701	91.10	1.88	91.40	32.29	89.00	41.02
4510	89.10	1.74	90.40	54.26	92.00	48.53
4516	95.00	7.68	95.50	120.10	95.50	68.63
4810	84.90	2.22	84.40	28.85	83.60	50.88

Table TA5: Solar installations per capita and separate house of 3 or more bedrooms of metropolitan and regional QLD data.

	2006		2011		2016	
	3 or More Bedrooms (%)	Solar Installations/ capita	3 or More Bedrooms (%)	Solar Installations/ capita	3 or More Bedrooms (%)	Solar Installations/ capita
BNE	69.10	0.19	78.50	49.31	77.90	38.65
4701	62.40	1.88	77.60	32.29	78.30	41.02
4510	70.60	1.74	82.60	54.26	81.60	48.53
4516	84.70	7.68	93.90	120.10	93.70	68.63
4810	49.00	2.22	47.10	28.85	48.00	50.88

Land Acquisition at the Urban Fringe: Assessing Compensation for Infrastructure Projects

Vince Mangioni

University of Technology, Sydney

Email: Vincent.mangioni@uts.edu.au

ABSTRACT

As cities develop and expand, moving through the phases of urbanization and re-urbanisation, the impact on existing residents and businesses results in the inevitability of land acquisition needed to support emerging land uses and infrastructure. This paper examines the purposes for which land is compulsorily acquired in Australia, and the evolving complexities in achieving this objective.

Cases are examined in identifying the purposes for which land is acquired and a survey is reviewed which encompasses the partial and total acquisition of land for a large infrastructure project. The case studies, survey and recent changes in land acquisition policy sets out a basis for achieving acquisition by agreement which aids in expediting the delivery of infrastructure. A contribution is made through the development of a framework that expands on options for reinstatement in place of monetary compensation and defines the factors to be included under the heads of compensation for disturbance and solatium.

Keywords: Reinstatement, Market Value, Solatium, Disturbance

1. INTRODUCTION

The compulsory acquisition of land is undertaken by all three tiers of government in Australia, with the States responsible for over 80 per cent of all acquisitions of which the acquisition of land for transportation is the dominant purpose, (Russell 2013:21). Each state and has its own enabling acquisition legislation which establishes the relevant heads of compensation payable and overarches the operation of the various government agencies undertaking acquisitions. It is highlighted by Brown (2010:3) that across Australia 'none of the nine statutes governing land acquisition are a model of excellence,' and that while the legislation was generally adequate, it is the 'factual complexities surrounding the tasks for claimants, administrators, valuers and the courts' is where the challenge arises. This is further compounded by the fact that the acquisition of land includes the taking of land on both a partial or total acquisition bases, which impact people's homes and businesses.

Across the capital cities of Australia, the current legislation has been suited to the acquisition of land in an evolving city environment, where traditional public purposes precipitated the need for land to be acquired for infrastructure, health, education and transport. Since the early 1990s, Melbourne, Sydney and parts of Brisbane have moved from the initial phase of land urbanisation, to a more complex rationale encompassing the regeneration and re-urbanisation of some locations and land uses (Property Council of Australia 2010). As set out in Table 1,

the complexity surrounding the acquisition and the emerging purposes for which land is acquired, resulting in the need for principles which clearly define and adequately compensate dispossessed parties. This further amplifies the need for compensation to address the fact that market value assumes the dispossessed party to be a willing but not over anxious seller, but does not address the parity of value principle, as the dispossessed party cannot always place themselves in the same position they were in prior to the acquisition.

Table 1: Acquisition types purposes and principles

Acquisition Type	Acquisition Purpose	Basis of compensation
Total – Piecemeal Method	Traditional – Infrastructure roads, health and utilities.	Market Value + Solatium + Items of Disturbance
Partial – Before and After Method	Non-traditional – housing, retailing and production.	
Existing compensation		**Proposed Compensation**
Existing and Alternate Application of the Principles of Compensation		Reinstatement = Parity of Value

Source: Author

2. ACQUISITION PURPOSES AND TYPES

The literature review focuses on two key factors which demonstrate the challenges confronting policy makers and legislators in drafting compensation provisions. The first factor relates to the purposes for which land may be acquired, the second relates to the approaches that are used to acquire land. What emerges from the review is that a gap exists in the parity of value, in particular where the dispossessed party is unable to be rehoused in similar premises within a similar or surrounding location or to re-establish their business resulting from its extinguishment.

Acquisition Purposes

Public purposes for which land may be acquired by compulsion have expanded over the past three decades in Australia to include the fast emerging rationale of economic development. While transport and utility infrastructure has been viewed as traditional public purposes for which land is acquired, these broad purposes now come under scrutiny where project development and ongoing operations are privatised. In the traditional sense, roads, rail, government health and educational facilities have been the staples of the perception of public purposes. In more recent times however, private housing and the regeneration of retail and office space have merged into what government has added to the definition of public purposes under the principle of economic development.

In meeting the needs of expanding cities and their populations, governments are taking more initiative in site assembly and amalgamation for uses beyond infrastructure. The public purpose rule in the site assembly process is described by Miceli (2004:218-219) as;

> *"a narrow economic rationale for eminent domain as a way of forestalling costly holdout problems that plague land assembly for large scale urban redevelopment projects, whether private or governmental. In this view, efficiency is served by any process that gets the land into the hands of parties who value it most highly."*

The overarching principle of utilitarianism provides the basis for the taking of land for the benefit of the greater community. This principle whilst not unchallenged has been accepted in the main for the taking of land for the provision of infrastructure, however is questioned for

the use of site assembly in urban renewal and redevelopment projects. Utilitarianism is described by Mill, cited in Hollander (2000) as an action which supports the greatest good for the greatest number of people. The primary question asked is how do tradition principles of compensation address non-traditional purposes of acquisition. The term economic development and its application do not proffer the same principles of compensation to those of infrastructure. This is particularly the case where the acquiring authority shares the uplift in value resulting from bringing land to its highest and best use. The developer and local government each sharing of a developers profit in contrast to a builder's profit margin associated with traditional infrastructure projects.

Types of acquisition: partial versus total acquisition

The compulsory acquisition of land entails two broad types of acquisition, the partial and total acquisition of land. Within each type of acquisition, different principles and legislative provisions have evolved in assessing compensation across the various jurisdictions. Common to both types of acquisition is the overriding principle of compensation for the market value of land taken, being a contestable measure on which part of the compensation is assessed (Hyam 2009). It is at this point that these two forms of acquisition diverge in practice but are assumed to be one resulting from the notion that value is determined on the basis of the parties being willing to but not anxious to trade on a given day. This factor solely relates to value in exchange, as defined under the Spencer Principle of market value, which features in both partial and total acquisition cases.

Beyond the market value of the land taken, the basis of a claim for compensation will depend on the type of acquisition and the impact of the acquisition on the dispossessed party. The form of acquisition will impact on the Heads of Compensation claimable and most importantly will drive the methodology used in the assessment of compensation. Figure 1 distinguishes the difference in a claim, the heads of compensation and the methods of assessment.
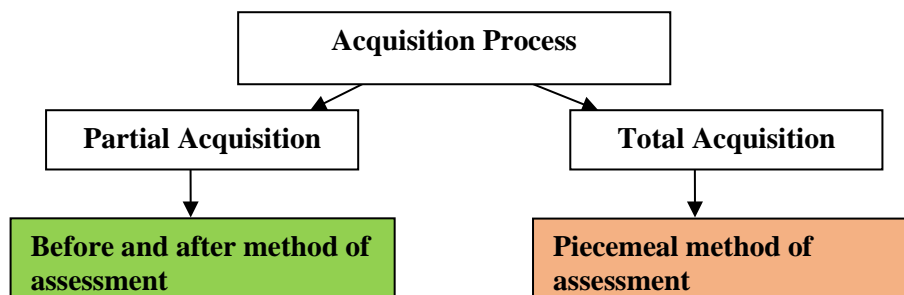

Figure 1: Total v Partial Acquisition Approach
Source: Hornby 1996

In assessing compensation in partial and total acquisition cases, Hornby (1996:307) sets out the formula in assessing each type of acquisition in accounting for the various heads of compensation as follows:

Partial Acquisition – Before and After Method:

(Before value **less** After value) **plus** Solatium and Disturbance = Sum of Compensation

Total Acquisition - Piecemeal Method:

Market Value **plus** Special Value **plus** Severance **plus** Solatium and Disturbance = Sum of Compensation

In the case of a partial acquisition, the use to which the acquired land is put and the impact of that use on the land retained by the dispossessed is to be accounted for in the after value and hence the compensation paid for head of market value. This includes any uplift in value where the retained land benefits from the use to which the acquired land is put or conversely, any loss resulting from an adverse use of the acquired land and its use. The method of capturing either a positive or adverse impact is defined by Hyam (2009) as the 'Before and After Method' of assessment. This method measures the value of the property before the acquisition and again after the acquisition where a portion of the land is retained by the dispossessed party. The difference in the before and after value captures each of the heads of compensation as set out in Figure 1, with the exception of items of disturbance and solatium.

The acquisition of land and the type of acquisition is primarily determined by the requirements of an acquiring authority which is dictated by the purpose and extent of the acquisition. An acquiring authority is not compelled to acquire any more land than is required for the public purpose for which it is acquired as set out in Minister for Public Works (NSW) v Duggan (1951) 83 CLR 824 and Thompson v Randwick Corporation (1950) 81 CLR 87. Whilst case law prohibits the taking of any additional land that is required for the public purpose, the State of Tasmania has the statutory power to enter into agreement under section 10 Land Acquisition Act 1993 to acquire more land than is required by agreement. In NSW, it is not uncommon for an acquiring authority to negotiate the acquisition of the total property, particularly in the case of residential property where a partial acquisition has been proposed and is not in the best interest of the dispossessed party to remain in occupation (Prentice 2002). Similarly, in cases of partial acquisition where the use of the acquired land so detrimentally impacts the retailed land, for example where the retained land is land-locked and looses all access, the difference between the before and after value may be close to the total value prior to the acquisition.

To this end, in addressing the full impact of the taking, the principles of compensation extend beyond market value to encompass items such as disturbance and solatium which are a safety net in recognition that the willing buyer willing seller hypothesis is only relevant to the assessment of the market value head of compensation. By virtue of the fact that market value is treated as a separate head of compensation, across all State acquisition legislation, is recognition that the parties particularly the dispossessed party is not willing and has no intention of selling when the acquisition notice is issued, unless the property is on the market for sale at that time.

Of particular note in Table 1 in distinguishing between partial and total acquisition, is the option for reinstatement where a party continues to reside or occupy the retained portion of the land not acquired. This is in contrast to a dispossessed party whose land is totally acquired and hence are forced to purchase an alternate property particularly in the case of a principle place of residence. In the case of partial acquisition for road widening, the principle of disturbance may extend to include items of capital expenditure such as double glazing, air-conditioning and other noise minimisation remedies. In other cases, this may extend to include the relocation of the existing house on the retained portion of the land where practical.

The above point marks the primary difference between partial and total acquisition, and in particular where a dispossessed party is able to reinstate themselves in a partial acquisition. This is in contrast to a dispossessed party the subject of a total acquisition, of which the total compensation is insufficient to reinstate their home or business where such interest is located in a marginal value location. This point is the subject of the next section of this paper and is elaborated on in the cases which follow.

Research Approach

Kumar (1996:86) refers to retrospective studies as a way of articulating the phenomenon of a problem or issue that has happened in the past and in this paper, it is transmitted through the examination of cases. The use of surveys to examine the results and attitudes of dispossessed parties is stated by Fowler (2009:1) to be a means of quantitatively measuring descriptions of outcomes of a study population. We use a secondary source being a survey of dispossessed owners conducted by Prentice (2002). While it is not possible to consider examples or cases covering the range of public purposes, the acquisition of land for road building purposes has been selected as a traditional public purpose and two cases examining acquisition for economic development are used to examine non-traditional public purposes. It is noted that most acquisitions for traditional public purposes are resolved by negotiation, Prentice (2002) highlights that less than one percent of acquisition matters for road construction or widening proceed to litigation.

Sydney M2 Motorway

The M2 motorway, originally known as the "North West Transport Link", is a 21 km road link, of four to six lanes, between Epping Road and the Lane Cove Tunnel in North Ryde and Old Windsor Road and the Westlink M7 motorway in Baulkham Hills Sydney. Construction of the motorway commenced in May 1993 and the roadway was opened in May 1997. In total, 246 houses were required to make way for the motorway in which the Roads and Traffic Authority (RTA), now known as the Roads and Maritime Services (RMS) were tasked with acquiring and consolidating the land required for this project. The initial acquisition step of the project, cost $120m which was spent on the acquisition of the residential property needed to undertake the development and accounted for approximately 20 per cent of the total project cost (Roads and Maritime Services 2013).

Research undertaken by Prentice (2002) measures the dispossessed's satisfaction of the process and compensation paid in achieving the objectives of acquisition for road works. In undertaking this research, a survey of 23 dispossessed property owners was undertaken on a number of key points which encompassed the acquisition process and principles used in assessing compensation. The 23 property owners surveyed were randomly selected from a pool of dispossessed residential property owners in which the acquiring authority provided details and access to parties from which land was acquired.

In this survey, it is acknowledged that the sample of three percent of dispossessed owners in NSW gives an indicative opinion of the success of the acquisition process and compensation principles. A summary of the key survey questions and results are set out in Tables 2 and 3 with discussion following:

Table 2: Survey summary with results expressed as a percentage

Question	Satisfied	Dissatisfied	Neutral
1) How satisfied were you with the amount of compensation paid?	74	22	4
2) Do you think the timeframe for the acquisition process was suitable	83	17	nil

Table 3: Survey summary to questions expressed as a Yes or No as a percentage

Question	Yes	No	Unsure
3) If the underground of your land were acquired for a tunnel or easement would you expect compensation?	100	nil	nil
4) Did you object to the amount of compensation that was initially offered by the acquiring authority?	61	39	n/a
5) Question to the 61 percent who objected in Q 4) above: Did your compensation amount increase?	36	64	n/a
6) In your opinion, do you think that the Commonwealth or State Government should have the power to acquire land?	22	78	nil

Source: Prentice 2002

In this survey, of the 23 parties dispossessed, 19 parties or 83 percent negotiated a settlement with the acquiring authority and 4 owners or 17 percent had their property compulsorily acquired of which 2 cases proceeded to court. In conclusion to this survey, participants were asked to give suggestions as to ways in which the acquisition process and compensation could be improved in the future. The key issues and feedback provided are:

1. **In the case of partial acquisition**: a majority of the parties who objected to the amount of compensation initially offered, were the subject of partial acquisitions and excluding the amount of compensation amount, were most dissatisfied with noise and access to their property during the works being carried out and time taken to carry out the works. The primary issue with partial acquisition was the non-claimable provision for the inconvenience factor experienced during the works. In these cases, the affected parties remained in their residences while road works were undertaken.

2. **In the case of total acquisition**: the key issue apart from the amount of compensation paid was the time frame for completion of the process. Of the parties who objected to the amount of compensation in these cases, the primary concern was the sufficiency of compensation to rehouse. Further, in each case the additional items of disturbance and solatium were generally considered sufficient in addressing the needs of the dispossessed for rehousing. It is further suggested that a compelling reason to settle by negotiation was to avoid living on a main road after road widening was complete.

Of the 23 respondents to the survey, 40% did not have any complaints or suggestions for improvement to the process. The compelling feedback and observations from this survey shows that in general terms the acquisition legislation was achieving its objectives in the case of residential property. In the cases observed, the primary area of disputation occurred in cases of partial acquisition of land. A further interesting point of note was the agreement of property owners not to fight the acquisition process, once they were aware of the works to be carried out and the impact those works would have on their property. In compulsory acquisition cases for road works generally across NSW, Bourke (Cited in Prentice 2002:62), provides the acquisition statistics at 95 per cent of all acquisitions are by agreement, 5 per cent by compulsory process with less than one per cent proceeding to court. In the case of the Sydney M2 Motorway, being the largest road works undertaken during the 1990s, 240 properties were acquired by agreement, 6 by compulsory acquisition, with 2 cases proceeding to court.

Badgery Creek Airport and South West Sydney

Sydney's first airport commenced operating in 1933 and in 1936 was officially opened and named Kingsford Smith Airport. In 1940 Bankstown Airport was built to service the war effort primarily used by the United States Airforce. As a small three runway airport, its use continues

primarily for pilot training and small craft, it is not considered to be Sydney's second Airport. By 1960 both NSW and Commonwealth Governments commenced developing a plan for Sydney's second airport, recognizing the geographic limitations of Kingsford Smith. In 1984, the Commonwealth Labor Government narrowed the options from five potential locations down to the options of Wilton and Badgery's Creek (Parliament of Australia 1998). Give the potential demographic location of Badgery's Creek and the topographical limitations of Wilton, the decision to proceed with Badgery's Creek was officially released by the Commonwealth in 1986 (Ibid).

In 1984, Badgery's Creek was a rural town with a population of approximately 1500 and located within the local government area of Liverpool with an area of 840 acres being 41 kilometers from the Sydney CBD. While considered to be the best location for Sydney's second airport, it has limited transport infrastructure to and from the greater Sydney Metropolitan Area (Liverpool City Council 2008). During 1986 the Commonwealth drafted plans to commence the acquisition of land at Badgery's Creek, this resulted in hardship for many property owners who were no longer able to sell their farms due the blight factor of the proposed acquisitions for the airport. The Blight Factor also known as the Woollams Principle recognizes hardship resulting from the inability of land owners to sell property unaffected by the proposal before government was prepared to acquire the land (Brown 2009).

Once the acquisition of rural property's commenced in the early 1990s, the Commonwealth commenced to acquire the roads around these property's from Liverpool Council. This led to extensive proceedings in the Federal Court[1] over compensation payable to council, in which Council claim the cost of maintaining the roads as an approach to determining value, to which the court disagreed. Both the approaches used by both the Commonwealth and Council were rejected by the court for the 32.63 ha of roads acquired. The amount of Council claim at $3.5m and the Commonwealth's offer of $340,000 were both rejected to which the court determined compensation at the sum of $192,000. Over the past three years the Commonwealth has worked with residents of Badgery's Creek in relocating and compensating them as the construction phase of the project is to commence in mid-2020. New provisions for solatium (the head of compensation for non-financial loss resulting from the loss of a residence) has assisted in mitigating some potential challenges and delays to the airport project.

Within the broader context of Sydney's expanding population, the proposed development of the south west corridor of Sydney gave rise to the need to plan transport infrastructure. This transport would later be used to connect and provide transport infrastructure between Badgery's Creek and the suburbs of Sydney's West Corridor (Australian Government 2018). In facilitating the development of transport infrastructure along the corridor more rural use property became earmarked for acquisition and dozens of farms were acquired to facilitate railway lines and stations. Among the farms acquired was that of the El Boustani's, tomato farmers and suppliers to many fruit and vegetable outlets across Sydney. The El Boustani's and surrounding farmers operated under existing use rights as the land was progressively rezoned to rural / residential land during the 1990s. Following the acquisition of their land, a challenge was successfully mounted to recover the cost of moving their tomato farm to a new sight.

While the El Boustani's were paid out for their land based on its value as developable land for residential use, their costs in excess of $900,000 for relocation of the farm were rejected under the long standing Milledge Principle, which operated in conjunction with the Sunderland Principle. In summary under the Sunderland Principle, a dispossessed over could only be compensated on the market value of their land on one basis of value, being its highest and best use. Running parallel with this principle, the Milledge Principle only allows the cost of

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[1] Council of the City of Liverpool v. The Commonwealth of Australia FCA 0009 of 1993

relocating the business on the land where the business use is highest and best use. The Milledge Principle has operated for over 50 years denying owners disturbance costs for relocating a business where an alternate use is more profitable than the existing use (Brown 2009). The El Boustani's appealed and the NSW Court of Appeal[2] which reversed the decision and rendering the long standing Milledge principle redundant, allowing the cost of the El Boustani's to relocate their business to other rural land they owned.

In the broader context of land uses in the surrounding locations of Badgery's Creek and the South West Corridor, many residential property and businesses owners have not been relocated to other land and as a result have lost their businesses and residences. While being paid out at the market value rate for their property and businesses, their inability to relocate has resulted from a number of factors directly resulting from the acquisition. These factors primarily result from the lack of supply of land within the immediate and surrounding locations to which they owned land. The acquisition of land and dispossession of owners results in competition of scarce limited resources from an increased number of purchasers attempting to relocate. To this end the supply of land reduces while the demand for land in the location increases, While not the subject of this paper we draw on the recent lessons from the Westconnex project in Sydney in one of the affected suburb of Haberfield. In that location over 200 houses were acquired in 18 months, in which the annual available turnover of houses in that suburb is approximately 40 per annum (Mangioni 2018). In this suburb, many property owners have been forced from owning to renting homes.

3. CONTRIBUTION TO A PARITY OF COMPENSATION FRAMEWORK

In addition to the market value of land compulsorily acquired, heads of compensation exist which attempt to account for non-financial loss resulting from the taking of land (Solatium) and for relocation expenses reasonably incurred in placing the dispossessed party in the same position they were in prior to the acquisition (Disturbance). These heads of compensation demonstrate that compensation beyond market value of the acquired land taken must be made and is founded on the premise that the willing buyer willing seller principle solely relates to the market value component in acquisition cases.

In drafting for reform, consideration is made on two bases, the first being the review of existing and emerging reforms in Australia, and secondly through the lens of a more radical approach which challenges some of the conventions which underpin the current principles of compensation. Of importance in the acquisition process is the option for the dispossessed to be reinstated where feasibly possible. While not possible in each circumstance, equivalence must also extend to rehousing the dispossessed with an interest in fee simple. In the case of investment property, this may also extend to include similar premises within the proposed development, where the acquisition is undertaken for economic development.

In building a framework to achieve such reform, both evolving provisions for solatium and disturbance are considered, as well as more radical reforms which address sharing in the uplift in value for non-traditional public purposes in which land is more intensely developed for economic development.

Reforming the heads of compensation other than market value

Current provisions for parity of compensation in addition to market value generally operate under two heads of compensation in Australia, these are Disturbance and Solatium. As set out

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[2] El Boustani v Minister for Administering Environmental Planning and Assessment Act 1979 [2014] NSWCA 33; 199 LGERA 198.

in Table 4, these heads of compensation vary across State jurisdictions. In addition to their operation in Australia, they exist in various forms internationally. Table 4 highlights the breadth of application of these two heads of compensation across Australia. It is noted the main divide in the provision for solatium, being a fixed amount versus a percentage of the total compensation, of which 10 per cent is used in Queensland and Western Australia.

Table 4: Solatium & Disturbance summary across Australia

Jurisdiction	Solatium	Disturbance	Reinstatement
VIC Land Acquisition & Compensation Act 1986	Up to 10% of total compensation	Section 41 Professional costs	Section 42 Purchase or intended purchase
Qld Acquisition of Land Act 1967	No Provision	Section 20 Reasonable professional & financial costs	No provision
NSW Land Acquisition (Just Terms Compensation) Act 1991	Up to $27,250 to $75,000 from 2017	Section 59 Items reasonably incurred for relocation, finance and acquisition costs.	No provision El Boustani case has assisted
South Australia Land Acquisition Act 1969	No Provision	Section 25 Not detailed	Section25 Similar to disturbance
Western Australia Land Administration Act 1997	Up to 10% of total compensation	Section 241 Removal & professional	No specific provision
TAS Land Acquisition Act 1993	Limited circumstances	Section 27 Reasonable costs	Section 31 Where no market
ACT / Commonwealth Lands Acquisition Act 1989	Yes, as decided by the authority or court	Section 55 Reasonable expenses	Section 58 No general market

Source: Various Land Acquisition Statutes

In Hong Kong an alternate safety net exists, referred to as the Home Purchase Allowance (HPA). The Home Purchase Appeals Committee (2007) sets out provisions for domestic property being an ex gratia HPA based on the replacement cost of a notional 7 year old property in the same location as the acquired property. This provides some recognition of the issues facing dispossessed parties and a measure of restoring dispossessed parties with an alternate property within the same location. The Hong Kong model is a tangible step towards reinstatement compensation.

In New Zealand, solatium for the purchase of a dwelling has recently increased from NZ$2,000 to up to NZ$50,000 in 2012. The $2,000 figure had not been updated since 1975 and it was decided that an increase was required to modernise the amount. Rather a set amount, the solatium is now on a sliding scale and provisions are currently being drafted within the legislation to set out the criteria to determine how much is paid in each case. One option is whether a component of this solatium could be paid on early agreement i.e. within 6 months of negotiations commencing, (Pers Com, Land Information New Zealand 2013). In addition, a new land-loss payment will be introduced, at 10% of the land value acquired to a maximum of NZ$25,000 for any one property (and minimum of $250). This reflects the view that an owner suffers disruption not just from losing a home but also if land is taken. This mirrors the UK

practice. If there is more than one owner, or more than one interest (e.g. freehold, lease) then the land loss payment is to be divided between those qualifying owners, (Ibid 2013).

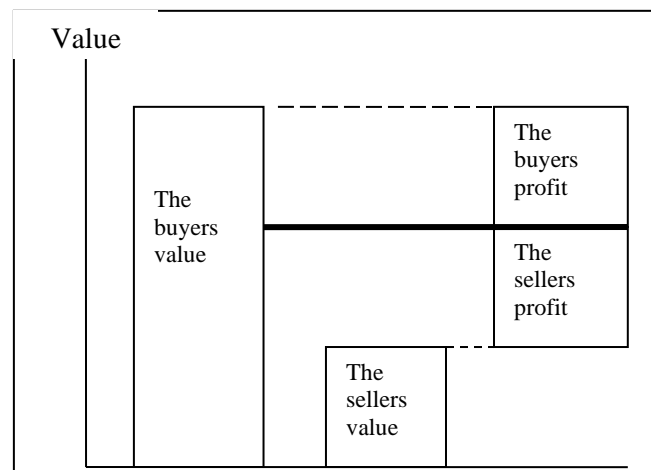## Mid-point for reform and profit share framework

In contrast to solatium and disturbance, Epstein (1985) proposes a sharing model in which any uplift in value is shared between the dispossessed and acquiring authority/developer. This model adopts the proposal of a low public interest project would results in a higher profit share and higher public interest results in a low or no profit share. The primary question is how would the degree of public interest be determined and what percentage would be provided to a dispossessed party along the variant scale of such determinations

In questioning the principle of the Epstein Model, Mills cited in Hollander (2000) discusses the defensible argument of utilitarianism being an action which supports the greatest good for the greatest number of people. Kalbro and Sjodin (1993) expand on the Epstein Model by defining the split in the uplift in value which is shared between the stakeholders to the acquisition as shown in Figure 2. This challenges the Raja Principle which contains the value of the property to the dispossessed and not the acquiring authority. This principle predominantly worked well in acquisitions for traditional public purposes.

In expanding the Epstein's model in support of the basic needs of a dispossessed party, an alternative model would commence with a reinstatement safety net, particularly in the case of a person's residence. An option to disturbance and solatium would be an alternate property reinstating the dispossessed. If this cannot be achieved, the dispossessed would be relocated in a property as close in value to the property acquired. This task and duty would be a responsibility of an acquiring authority in which there resources would be used rather than the dispossessed if that were the choice of the dispossessed. Where the dispossessed party live in marginal value locations, then an alternate property within the same or surrounding location up to the average value of property within that location may serve as an alternative.

In these cases where a livelihood is extinguished, the profit sharing arrangements of Epstein could be adopted to form part of the compensation. Adopting a broad brush approach to providing a dispossessed party with a profit share from a low public interest project could be fraught with inconsistency without considering the circumstances on a case by case basis. In applying the Epstein model or mid-point options of profit sharing to the cases of Badgery's Creek and South West Sydney property, both may have been resolved avoiding protracted litigation and unnecessary legal costs. In the case of El Boustani, the Plaintiff was reinstated with their alternate land and hence an eventual but protracted mid-point was reached. However for many of the surrounding residents were not afforded the same benefits. In applying either the Epstein or mid-point framework, each owner could have been either relocated for provided with sufficient compensation to be re-housed within or close to the location their land was acquired from.

In the case of owners affected at the airport sight, simpler options may have been available by offering alternate rural land in surrounding locations, which also accommodated rural uses. Alternatively a profit share of the uplift in value could have been offered as part of the compensation in recognition of the potential similar use to which the land may be put. Rather than each side incurring legal costs of many hundreds of thousands of dollars, these funds are better directed through profit sharing with the dispossessed party. This case demonstrates that lack of commercial acumen where an acquiring authority is unable to move beyond the market value head of compensation and divert cost incurred attributed to items of disturbance in in the form of legal costs to either reinstate or compensate the party for solatium.

Figure: 2 Voluntary agreed price - buyer/seller profit

Source: **Kalbro and Sjodin 1993**

4. CONCLUSION

The purposes for which land is acquired have expanded in the re-urbanisation phase of highly developed cities to encompass both traditional and non-traditional public purposes. The necessity to be able to acquire land for both of these broad purposes is important and necessary in regenerating underdeveloped and obsolete land uses. In undertaking the acquisition process, it is important that all stakeholder needs are addressed and options are available for reinstatement of a dispossessed party, particularly in the case of economic development where a dispossessed party may be rehoused or their business relocated within the new development. This will still necessitate the need for disturbance while such development is being built, alternatively the Epstein model of a profit share model may be an option.

It was further shown that in partial acquisition cases, a form of reinstatement does exist, in which items of disturbance form part of the compensation in allowing the dispossessed party to relocate on the retained potion of their land where practical. This option needs to be expanded to provide similar protection for owners who are the subject of total acquisitions, in which costs of relocating under items of disturbance must also include such professional services as buyer agents and location specialists. This is particularly the case where the acquiring authority does not participate in the relocation process.

It was demonstrated that a difference exists in attitudes towards the options in the case of road widening purposes versus economic development, however in each purpose, particularly in marginal value locations reinstatement is an important safety net for a dispossessed owner. To this end, it was further shown that solatium and items of disturbance are within existing legislation in Australia and are being strengthened as is the case internationally. This supports the fact that beyond the determination of market value, that the parties to an acquisition in particular the dispossessed, are not willing and the requite heads of compensation must reflect that fact.

The equivalence principle must go beyond that of the equivalence of market value and encompass physical or economic equivalences in acquisition cases. This will place greater pressure and resourcing the acquisition process, however in the case of economic development, where more intense uses of land underlie the acquisition of land, the Epstein Model is an option in which the developer in concert with the acquiring authority may minimise lengthy hold-outs by accommodating the needs of the dispossessed through either a profit share or reinstatement options are worthy of further exploration.

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The Role of 'Social Licence to Operate' in Fostering Sustainable Business and Sustainable Regional Development

Daryl Plandes

Central Queensland University

Email: d.plandes@cqu.edu.au

ABSTRACT

Businesses contribute significantly to the socio-economic development of regions by generating revenues, creating jobs and stimulating infrastructure development. Sustainable regional businesses and sustainable regional development go hand in hand. Following the UN 2030 Agenda for Sustainable Development, sustainable regional development addresses and balances the three dimensions of sustainable development: economic, social and environmental. If regional businesses are to assist in achieving sustainable regional development, they too must work towards economic, social, and environmental sustainability. Social licence to operate (SLO), a concept that emerged from the extractive industries, can be a suitable framework for sustainable business development. SLO denotes ongoing acceptance or approval of a firm's activities by different stakeholder groups. Businesses that have an SLO face minimal stakeholder resistance and create goodwill which enables them to have support for subsequent projects. Thus, SLO leads to business economic sustainability whilst addressing social and environmental concerns. By employing an instrumental approach, this paper argues that if regional businesses achieve social, economic and environmental sustainability through SLO, they can foster sustainable regional development.

Key words: social licence to operate, legitimacy, sustainable development, regional development.

1. INTRODUCTION

Communities in remote regions still deal with poorer work opportunities, healthcare, education, and infrastructure, and face greater health risks compared to those in urban areas (Sorensen, Marshal & Dollery, 2007). Regional development aims to eliminate or minimize this disparity through the efficient utilization of internal and external socio-economic factors (Buultjens, Ambrosoli & Dollery, 2012).

Regional businesses provide a multitude of direct and indirect socio-economic benefits to regional areas. They raise national and regional revenues, create jobs and stimulate infrastructure development (Kauppila, Saarinen & Leinonen, 2009; Uzgova & Razgulina, 2015). Moreover, regional businesses, mining firms for instance, attract settlers to regional areas and generate taxes and royalties which form part of the national income that is used to fund the upgrade and development of roads, ports and other similar infrastructure (Lacey, Parsons & Moffat, 2012; Ivanova, 2014; Artobolevskiy, Gorkin, & Smirnyagin, 1984). The

sustainability of these regional businesses, therefore, is essential to the sustainability of regional development.

In the extractive industry, scholars have found that firms that secured a social license to operate (SLO) were able to improve their legitimacy and the acceptance of their activities which improved their socio-economic sustainability as a business (Parson et al., 2014). SLO refers to the ongoing acceptance of a firm's activities by communities and shareholders that affect its profitability (Moffat & Zhang, 2014).

This paper focuses on the role that regional businesses play in regional development and views SLO as a tool that regional businesses can utilise to improve their sustainability. The author argues that businesses aiming to drive and maintain regional development should secure an SLO. This paper is structured as follows: following the introduction is the literature review which examines the contribution of businesses to regional development and how firms in the mining and other extractive industries benefited from obtaining an SLO. The paper then discusses the origins of SLO as a concept and how firms have operationalised it. Included in the discussion are cases involving firms that have improved their legitimacy through SLO and firms that faced opposition for failing to secure an SLO.

2. LITERATURE REVIEW

Regional Development

There is an imbalance between Australia's urban centres, and regional/ rural areas in terms of economic diversity, employment and business opportunities, access to services, income levels, and other well-being metrics (Sorensen, Marshal & Dollery, 2007). This imbalance is reflected in the Socio-economic Indexes for Areas (SEIFA) Index of Disadvantage reported by the Australian Bureau of Statistics (ABS, 2016). The greater the remoteness of a rural community, the greater is its disadvantage (Sorensen, Marshal & Dollery, 2007). In order to make life in regional Australia a socially and economically feasible option, regional development seeks to ease the pressure brought about by different socio-economic challenges such as unemployment and shortage of manpower (Hettihewa & Wright, 2018, Taylor 2017).

A major regional development challenge started in Australia in the 1970s when farms closed down due to increasing global market competition, rising input prices and falling commodity prices forced economic deregulation which involved reducing tariff and removal of import restrictions to agricultural products and other regulations that protected industries—all of which forced farming families to leave their respective   areas and move to urban regions (Tonts, 1999). This was a crucial setback to regional development as these residents served as a source of workforce and customer base for shops, banks and other local businesses (Smailes, Griffin & Argent, 2016).

Regional development entails efficient utilisation of natural resources, workforce, finance, 'infrastructure', industry, 'leadership', 'local institutional capacity' and business activities to drive the continuous and sustainable growth of regions and its people (Buultjens, Ambrosoli & Dollery, 2012). Regional development has always been considered as one of the major activities and responsibilities of state governments (Tonts, 1999). In Australia, regional development strategy has moved from the top-down approach to bottom-up also referred to as 'regionalism' and this new approach empowers communities, focuses on the local industries and takes into consideration the social and cultural norms of local communities (Buultjens, Ambrosoli & Dollery, 2012).

Regional development could contribute to addressing present-day socio-economic challenges.

Hettihewa & Wright (2018) identified providing employment as regional small businesses' primary contribution to regional development and availability of opportunities encourages the local workforce to stay in the region which is very important in maintaining the socio-political stability in that area.

UN 2030 Agenda for Sustainable Development

The United Nations 2030 Agenda for Sustainable Development prescribes a plan of action and important measures to address the economic, social and environmental concerns our society is currently facing. The agenda envisions a dignified way of living for each individual and allowing him or her to reach his or her potential; sustainable consumption and stewardship of our natural resources in order to meet the needs of the present and future generations; prosperous and fulfilling life for everyone; and peaceful, just and inclusive societies which are free from fear and violence (UN, 2015). This paper argues that if firms conduct their business according to these principles, they would gain legitimacy and a positive reputation resulting in greater socio-economic sustainability and help promote a more sustainable regional development.

Social Licence to Operate (SLO)

Businesses in natural resource-extractive industries should have a social licence to operate (SLO) particularly from the local community in order for them to operate sustainably (Owen & Kemp, 2013; Cooney, 2017). Under this view, SLO is continually granted (Nwapi, 2016) and this means that a business should have ongoing support from the local community. SLO is considered as a concept that is closely related to Corporate Social Responsibility (CSR) and that it focuses on meaningful relationships with local stakeholders (Hall, Lacey, Car- Cornish & Dowd, 2015).

The term 'social licence to operate' was first used in the mining industry where it has had the most widespread practice and is now being observed in other extractive industries like pulp and paper mills (Gunningham, Kagan & Thornton, 2004), coal seam gas (Lacey & Lamont, 2014; Paragreen & Woodley, 2013), unconventional gas (Curran, 2016), wind energy (Corvellec, 2007), forestry (Edwards, Lacey, Wyatt & Williams), farming (Williams & Martin, 2011) and aquaculture (Baines & Edwards, 2018).

The SLO is important to the viability and sustainability of business operation and it has also been closely associated with 'legitimacy' or the perception that one's activities are appropriate or desirable (Hall et al., 2015; Parsons, Lacey & Moffat, 2014). After witnessing a series of highly publicized reputational blunders like that of Nike, Monsanto, and Shell, businesses seek more effective risk management strategies and SLO has become an important tool in determining whether there is a need to go beyond compliance to their legal obligations (Gunningham et al., 2004).

Due to the singular form of the term Social Licence to Operate, the concept was initially misunderstood to be something that is obtained from a single group at just one given point in time (Jijelava & Vanclay, 2017). In addition, it is very difficult to ascertain who has achieved legitimacy and when has one lost it. This difficulty is a testament to the dynamic nature of SLO and its requirement for 'ongoing negotiation' (Parsons et al., 2014).

According to Thomson & Boutilier (2011), SLO is a continuum of licences obtained from different community groups. But there is an emerging understanding that there is more than one SLO to be obtained and that these licences accumulate to strengthen the overall SLO of the business and industry (Dare, Schirmer & Vanclay, 2014). In gaining and maintaining SLO, it is not only the expectations of the local community that needs to be met but also those of

others including countries, industry workers, human rights advocates and national and international consumers (Mayes, 2015). The idea is that while nearby communities are directly affected, the benefits from these business activities are communicated to a broader audience. The issuance of the consent, therefore, does not lie solely on the communities along the "fenceline" (Gallois, Ashworth, Leach & Moffat, 2017).

In some instances, stakeholder groups with the most resources can fund campaigns. The social media drives have the most control over the issuance or withholding of the SLO (Cullen-Knox et al., 2017). An important question however that companies need to answer is whether the opposition, protesters for example, represents the majority of stakeholders (Smits, Justinussen & Bertelsen, 2016).

SLO issued, withheld or withdrawn?

There is a view that it is much easier to tell whether an operation or company does not possess an SLO and it is usually based on existing oppositions in the form of protests and blockades (Smits et al., 2016).

There have been major developments in the process of withholding of an SLO. In the past, oppositions used traditional avenues to express their grievances but with the advent of social media, commerce and communication broke geographical and political boundaries. An interest group in one location, a country for example, can now show their support for a particular cause in another location using social media making the process of garnering support much quicker (Cullen-Knox et al., 2017). The existence of negative publicity is often used to assess whether a social licence has been obtained or withdrawn (Heikkinen, Lepy, Sarkki & Komu, 2013).

Following the idea that SLO should be maintained, companies should follow through with their commitments and that failure on their part to do so would immediately result in withdrawn SLO and negatively affect the SLO process for upcoming projects (Lansbury Hall & Jeanneret, 2015).

3. INSTRUMENTAL APPROACH TO SLO

How have firms managed to obtain an SLO?

Community engagement is one of the effective ways to obtain an SLO at the 'local level' as evidenced by findings from case studies in the forest management sector in Australia and Canada (Dare et al., 2014). In negotiating for SLO, companies would benefit from getting a deeper understanding of their target audience, as well as their values and motivations. This should be supplemented by communication strategies that are designed specifically for each of the stakeholder groups (Gallois et al., 2017). A one-size-fits-all approach is more likely to fail. In using scientific and highly technical terminologies when explaining concepts for example, some stakeholders would immediately understand and appreciate the message. Other groups, however, would feel alienated and excluded, as they do not engage with the communication. In the process of negotiating to obtain SLO, businesses tend to isolate the dialogue to the local community or those who are around a specific operation overlooking other stakeholders that are also affected by the operation (Gallois et al., 2017).

Procedural fairness, a concept closely associated with SLO has a slightly different perspective. Contrary to an earlier understanding of the concept where it was viewed as a one-sided process of 'box-ticking' or completing a checklist, procedural fairness is achieved when stakeholders are involved in a dynamic and collaborative discourse (Mercer-Mapstone, Rifkin, Louis & Moffat, 2017).

SLO campaigns, contrary to popular belief, are not usually based on scientific research. In some cases, it is composed of carefully written narratives of NGOs designed to appeal to the public's normative values and perception of an extractive operation's environmental impacts (Murphy-Gregory, 2018). In Iceland and The Faroe Islands, the success of the hydropower and geothermal energy companies in securing economic legitimacy, which translates to an SLO in the acceptance level, relies heavily on providing clear and identifiable economic benefits to the local community. The economic benefits in this context go beyond the taxes and tariffs but from being involved in the design, construction, operation, and development (Smits, Justinussen & Bertelsen, 2016).

Stakeholder engagement through strategic communication is essential in obtaining SLO, as it is the first step to creating a productive relationship between a company and stakeholders (Lansbury Hall & Jeanneret, 2015). Effective communication with stakeholders is essential not only to gaining acceptance but in fostering a deeper relationship between a company and the community. The relationship was found to be the main result of dialogue (Mercer-Mapstone et al., 2017). Collaborative SLO approach refers to the process whereby firms and communities discuss their respective concerns and decide to compromise (Harvey & Bice, 2014).

The solidified understanding of society's expectations helps businesses secure and maintain SLO (Buhmann, 2016).

Evidences from the extractive industries

Empirical evidence suggests that in the absence of a social licence to operate from a local community, businesses can be faced with resistance usually in the form of protests and blockades which result to costly delays in the operations and in some cases, permanent cessation of business (Zhang et al., 2015), similar to what happens when governments refuse to issue permits (Boutilier, 2014). As a result, companies in these industries seek to obtain a social licence from the local communities in addition to securing business permits and licences (Bahr, 2015).

Highly environmentally conscious consumers' displeasure can be observed in their personal choices—they immediately stop patronising products referred to as 'individual boycott behaviours' and they are also more participative in collective action against a product or firm (Russel, Russel & Honea, 2016). Surprisingly, even individuals with low environmental consciousness are also taking punitive actions in the form of their personal consumption choices against companies who have failed to meet their environmental commitments (Russel et al., 2016). Firms that have successfully obtained SLO on the other hand have successfully minimised the risks associated with these oppositions, maintained an outstanding reputation and contributed goodwill in favour of their respective industries all of which enabled them to operate sustainably (Smits, Justinussen & Bertelsen, 2016; Lansbury Hall & Jeanneret, 2015: Russel et al., 2016).

4. DISCUSSION

The social licence to operate was first studied in the Mining and Extractive (M & E) industries. The view is that it is very important in the operational sustainability of a company and that the lack of it could lead to opposition in the form of rallies, protests, blockades, and boycotts. These activities could potentially cause delays and in some cases complete cessation of a business operation. In the case of Monsanto, their failure to address consumers' concerns about the introduction of genetically modified food resulted to loss of public trust which eventually led to corporate restructuring (Gunningham et al., 2004). Nike experienced the same reputational

blow due to its publicized labour exploitation issues (Wilburn & Wilburn, 2011; Gunningham et al., 2004; Russel et al., 2016).

This paper argues that social licence to operate (SLO), a concept that emerged from the extractive industries (Thomson & Boutilier, 2011), can be a framework for sustainable business development. SLO denotes ongoing acceptance or approval of a firm's activities and practices by different communities (Thomson & Boutilier, 2011; Dare et al., 2014) and stakeholder groups including socio-political organisations (Parsons et al., 2014; Moffat & Zhang, 2014; Lacey & Lamont, 2014). Businesses that have an SLO face minimal resistance and opposition from stakeholders (Russel et al., 2016; Smits et al., 2016) and create goodwill which enables them to have support for subsequent projects (Lansbury Hall & Jeanneret, 2015). SLO then leads to business economic sustainability (Pilot, 2014) whilst addressing social and environmental concerns.

In the Australian mining industry, groups that are associated with issuing SLO may refer to local communities, non-government and other community groups, businesses in the same industry or situated within the same location, landowners, indigenous groups, industry regulators and associations (Bice, 2014).

5. CONCLUSION AND RESEARCH OPPORTUNITIES

Social licence to operate as a concept has become a prominent fixture in the extractive industry literature especially in discussing failures and successes within the industry.

Firms in the mining, pulp and paper mills, coal seam gas, unconventional gas, wind energy forestry, farming, and aquaculture industries have considered obtaining SLO to maintain and/or improve their socio-economic performance. Those who have secured SLO minimised risks from oppositions, improved their reputation and created goodwill for their firms and the industry. Those who failed to obtain or maintain SLO eventually faced opposition which caused them significant losses. Due to the natural resource-intensive nature of these businesses, they normally operate in the regional areas where there is an abundant supply of raw materials for their respective operations. The next logical move, in this case, is to apply the SLO concept to regional businesses as a whole, regardless of industry. Since the importance of regional businesses to regional development is broadly accepted and sufficiently documented, it is fitting to say that SLO helps businesses improve their socio-economic sustainability which in turn contributes to sustainable regional development.

This study, however, does not demonstrate the presence of SLO in every industry in regional areas. Proving such requires an in-depth and industry-focused empirical study and could be an opportunity for future research.

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Every community wants an airfreight facility: Is this a viable regional agricultural supply chain development option for central Queensland in Australia?

Azad Rahman, Delwar Akbar, John Rolfe

Central Queensland University

Email: a.rahman2@cqu.edu.au

ABSTRACT

Central Queensland (CQ) is one of the agriculture intensive regions in Queensland. This region produces a range of perishable agricultural commodities, which have high demand in the Asian markets. Perishable commodities require a well-developed cold supply chain with air freight facilities for transporting fresh commodities to international markets. This paper examines the viability of developing air freight facilities in central Queensland for exporting perishable commodities to Asian markets. A mixed methodology consisting of a literature review, a stakeholder workshop, and qualitative and quantitative data analysis was used for this research. This study found that 71% and 18% of the total production of beef and horticultural products respectively are currently exported from Australia. Some potential issues, including the risk of inconsistent supply, lack of locally based processing and packaging centres, and lack of enabling supply chain infrastructure were identified during the stakeholder workshop. Most participants were looking for improvement of the existing airport into an export-oriented business hub, which could provide local producers with better access to international markets. However, the supply data analysis indicates that the existing supply of horticultural products is insufficient to develop export facilities in the current airport(s) in the CQ region. It was suggested that the development of inter-regional horizontal collaboration among producers would enable CQ to be a potential perishable agricultural commodity exporting zone. However, another option would be to develop an air freight network with the existing export-oriented airports.

Keywords: Perishable agricultural commodities, horizontal collaboration, inter-air freight network, export, Asian markets.

1. INTRODUCTION

Many Asian nations, including China and India, are experiencing rapidly growing populations and the emergence of a wealthier middle class (EIU, 2014). These Asian countries are increasingly using global imports to satisfy food demands (EIU, 2014). World demand for agricultural commodities is expected to increase about 77 per cent by 2050 because of global population increase, growth in per capita incomes and increasing urbanisation, especially in Asia (Ash et al., 2014). Consumption of perishable products including fruits and vegetables are also projected to increase significantly (Ash et al., 2014).

The current free trade agreements with different trade partners in Asia provides opportunities for the central Queensland (CQ) region to increase trade through exports. It is important to ensure an enabling infrastructure and trading facility framework will be in place to strengthen the trade relationship with international partners. Current supply chains are largely geared towards domestic markets with road and rail transport though to port facilities. However, a sustainable export supply chain could involve an efficient air-transport hub with processing, storing and container facilities and cargo planes. Currently, only Toowoomba and Cairns are regional centres that have such a hub. One of the largest and agricultural intensive regions in the state is central Queensland. Apart from the major production of beef and sugar, CQ produces horticultural crops including many varieties of tropical fruits, which are mostly perishable goods. Exporting high-value horticultural commodities and tropical fruits to the Asian markets may be a major economic opportunity for CQ.

World merchandise trade reached to 19.67 trillion US$ in 2018 (WTO 2019) and air transportation holds about 40% share by value of world trade in goods (Rodrigue et al. 2017). In Australia, several agricultural commodities are transported by air freight to both international and domestic markets. Currently, most of the international airfreight from Australia are shipped through major international airports which are located in capital cities. Only a few regional airports have the capability to accommodate wide-body cargo aircraft (AgriFuture Australia, 2019). In a recent government-issued report, an emphasis was placed on enhancing regional export opportunities through the development and/or up-gradation of regional airports (DIRDC, 2018)

Due to the perishable nature of major agriculture products of CQ, it is important to study the export supply chain and the potential for air transport facility (transportation option with the shortest time) in this region for future economic growth. This study aims to examine the viability of developing air freight facilities in CQ to export perishable agriculture commodities from the region.

The rest of the paper is organised as follow: Section 2 provides an analytic framework based on the relevant theoretical domain. Section 3 presents a literature review on the role of regional airports in economic development and perishable agriculture commodities supply chain. Section 4 describes the methods and materials of the current study. Section 5 presents the analysis and findings of the study and section 6 conclude the paper with a brief discussion and some recommendation.

2. BACKGROUND OF THE STUDY

Regional economic development

Region is a spatial unit, and researchers use the administrative classification to define a particular region which is different from the other regions. Categories of classifications are based on geography, climate, natural resources and socio-demographic concentration (Beherens and Thisse, 2007). Regional systems involve interactions of social, economic and environmental phenomena between and within the regions.

The strength of a regional economic system is based on achieving specialization through production. Regional economic development theories, including international trade theory, are considered as a key tool in regional development study (Dawkins, 2003). However, recent approaches are more realistic and dynamic and based on three basic theories: development theories, location theories and growth theories (Capello, 2019).

Agricultural supply chain

An agricultural intensive region can contribute to regional economic development by enhancing the efficiency of the supply chain and increasing production, which will provide a competitive advantage to producers. The strategic capabilities of a farm can be enhanced by systematic utilization of resources and integration among all the parties involved in the supply chain (Wong 2011).

The transaction cost is also one key measure for the performance of a farm. To enhance performance, transactions need to be completed with minimum costs involved. A transaction is defined as the transfer of products or service from an upstream to a downstream production stage (Bremen et al., 2010). These transactions stimulate a farm's activities either in the form of vertical integration or through market mechanisms (Cao et al., 2010).

Specialization

The specialization phenomena could lead to several benefits, including an increase in sales, value-adding activities, better competitiveness, lower transaction costs, technological intervention and regional diversification (Czyzewski and Smedzik-Ambrozy, 2015, Balland et al., 2019). Stakeholders in an agricultural supply chain could play a vital role in improving specialization. The effort for specialization could be directed in different dimensions. However, in the current study and the context of central Queensland region, we are focusing in three main categories which are: increasing production of high-value perishable agriculture commodities, availability of resources, and multimodal transportation systems.

3. LITERATURE REVIEW

3.1 Role of air freight hub in regional setting

Airports in any region are considered as strategic infrastructure due to its function to connect regions. The literature indicates that an airport could contribute to the local economy through four impact categories: direct impact, indirect impact, induced impact and catalytic impact (Halpern & Brathen, 2011; Percoco, 2010). Employment opportunities and revenue from an airport generate direct contributions in the economy, while the profits obtained from engaging suppliers of goods and services may be considered as an indirect contribution. Induced impacts on an economy occurs by the spending of income of employees in the local business. The airports can also act as a driver for the growth of other associated industry, and this type of impact is considered as a catalytic impact (Baker et al., 2015). The literature also suggests that there is a strong correlation between air transport and economic growth of a region, although the nature and the degree of correlation depends on several characteristics of the region (Mukkala & Tervo, 2013).

While passenger transport is the major function of airports, we are only focusing on goods for transportation and more specifically on perishable agriculture products in the current paper. Regional airports may provide a region with better access to international markets as well as enhancing the attractiveness of the region for future investment (Tveter, 2017). Different researchers have studied the impact of airports on regional development (Sellner & Nagl, 2010, Tveter, 2017, Hansen, & Johansen, 2017) and affirmed the linkage. In the Australian context, researchers have studied the cointegration and causality analysis (Baker, et al., 2015) and challenges to domestic air freight (Alexander & Merkert, 2017).

3.2 Supply chain for perishable agriculture commodities

A supply chain is an organizational network which produces value from a product or service for consumers through different process and activities. Supply chain management (SCM) can be defined as the management of upstream and downstream suppliers and consumers to provide superior customer value for the product or service at less cost to the supply chain as a whole (Christopher, 2016). Supply chain management deals with complex interactions among supply chain members and decision-making problems (Chandra & Grabis, 2016). The perishable nature of agricultural products makes their supply chain more complex compared with other products. Short shelf-life and appropriate temperature control during storage and transportation are the major challenges regarding perishability. The common challenges in perishable commodities SCM are described below.

*Cold storage logistics***:** it is important to control the temperature during storage and transportation to ensure appropriate product quality at the end of the supply chain (Bogataj et al., 2005). In the global market, sets of regulations are established for perishable product handling and exporting, which need to be complied with by the enterprises.

Integration: Integration with suppliers and consumers is one of the key elements in the SCM of the perishable commodities and it could offer potential benefits to all parties (Alfalla-Luque et al., 2013). Supply chain integration could be categorised in three broad classifications: technical perspective, managerial perspective and relationship perspective (Awad and Nassar, 2010).

Transportation: One of the substantial challenges of perishable commodities SCM is loss and damage during transportation (Ruiz-Garcia and Lunadei, 2010). To reach the global market several transportation steps may be required, were any disruption in the temperature control on the process may lead to low-quality products (Aung and Chang, 2014). Temperature requirements for food items are varied due to the product type and perishable nature (Table 1).

Table 1: Variation of storage temperature for different fruits and vegetables

Storage temperature range		
1-4º C	5-9º C	10º C +
Apple, berry fruits, grapes, peach, plum, broccoli and lettuce.	Avocado, passion fruit, capsicum, mandarin, orange.	Avocado (subtropical), lemon, mango, banana, pineapple, tomato, sweet potato.

Quality: Maintaining strong quality assurance is one of the important factors for processing commodities and distributing across the food chain (Trienekens and Zuurbier, 2008). Food product quality is also closely related to food safety, which is another critical aspect for consumers (Wang and Li, 2012).

Market demand information: Detailed and up-to-date information on market demand and supply is another key element of SCM for perishable commodities. A lack of market demand information could lead to inefficient supply chains, such as those characterised by a delay in production and delivery scheduling (Thron et al., 2007).

4. METHODS AND MATERIALS

The research approach in this paper combined a literature review on types and volumes of perishable agricultural commodities in central Queensland (CQ), a stakeholder's workshop, a review on the existing airports in CQ and qualitative and quantitative data analysis. Data sources include Australian Bureau of Agricultural and Resource Economics (ABARES), Australian Bureau of Statistics (ABS), Queensland Land Survey, Queensland Department of Agriculture and Fisheries (QDAF), Bureau of Infrastructure, Transport and Regional Economics (BITRE) and Meat & Livestock Australia (MLA). To examine the feasibility of the local airport as a potential air transport hub for exporting of perishable agricultural commodities data have been collected from the airport authorities and local government database. Relevant literature of case study on air transport hub was also collected and reviewed.

Findings from the literature review and secondary data have been presented in a stakeholder's workshop; where representatives from the Queensland Government's state planning and agricultural departments, peak agricultural industry representatives, regional economic and tourism development organizations (eg. Capricorn Enterprise), commercial growers, and farmers attended. The purpose of the workshop was to understand stakeholder perceptions about the export potential of perishable agricultural commodities and the importance of building an air-transport hub in central Queensland. This study utilized a narrative analysis and some degree of content analysis. Collected data from the secondary sources are scrutinized to fulfil the purpose of the study. Both qualitative and quantitative data have been collected throughout the study. Based on the analysis of the study a few recommendations are listed to promote perishable agricultural commodities of CQ for exporting into the Asian market.

5. FINDINGS AND ANALYSIS

5.1 Perishable commodities in the central Queensland region

Central Queensland is a Level 4 Statistical Area of Queensland government (QGSO, 2019) with six local government areas (LGA). This region has a sub-tropical climate with moist and warm summer and dry winter. The major industries of this region are agriculture and natural resources (primarily thermal coal).

Perishable commodity refers to the unpreserved commodity that has a limited shelf time (about 7 days) after initial processing or harvesting. Most agricultural commodities are perishable in nature. A range of perishable commodities, including chilled beef, vegetables, fruits and herbs, are produced in the CQ region. Table 2 summarises the production of key perishable commodities of the CQ region.

Beef is the predominant agricultural commodity in central Queensland as well in the State of Queensland. In 2017-18, Australia produced approximately 2.24 million tonnes carcase weight (cwt) of beef among which 48.1% came from Queensland (MLA, 2018). In 2017-18 Australia exported about 71% of its total beef production (MLA, 2018). Central Queensland produced about 33% of the total beef production in Queensland (TIQ, 2016).

The value of Australian horticulture exports reaches to 3 billion AUD in year 2018-19 by exporting about 18% of total horticulture production (ABARES, 2018). In horticulture, Central Queensland produced about 17 thousand tonnes of pineapple which is about 19% of Queensland's pineapple production (ABS, 2018. The tropical climate in the CQ region is very suitable for growing all varieties of melons (Watermelon, Rockmelon and Honeydew melon). About 3.6% of Queensland produced melons are from CQ region.

Table 2: Major perishable commodities of Queensland

Perishable commodities	Queensland production tonne	Production volume (tonne) in CQ/Fitzroy	Percentage
Beef (MLA, 2018, TIQ, 2016)	1,110,816	366,570	33%
Banana (ABS 2018)	363,315	Not reported	0%
Fresh Vegetable (Tomato, lettuces, capsicum, cabbages, broccoli) (ABS 2018)	167,090	57	0.034%
Melons (ABS 2018)	89,438	3,200	3.6%
Pineapple (ABS 2018)	87,497	16,784	19.2%
Mandarin (ABS 2018)	70,280	453	0.64%
Citrus (excluding Mandarin) (Hort Innovation, 2019)	52,341	148	0.5%
Mango (ABS 2018)	34,871	1,290	3.7%
Avocado (ABS 2018)	33,785	45	0.13%
Strawberry (ABS 2018)	31,962	3.5	<0.01%
Barramundi and Prawn (Aquaculture) (Savage, 2015, Heidenreich, 2016)	7, 882	80.8	1.02%
Grapes (ABS 2018)	7,704	3,368	43.7%
Lychee (ALGA, 2017)	3,000	600	20%
Fresh herbs (Parsley, coriander, basil. Mint, chives) (ABS 2017)	4,640	1,546	33.3%

Queensland produces 60% of Australian mandarin and each year Australia exports about 35,000 tonnes of mandarins mostly in China and South-East Asian countries. Mango is another major commodity of Queensland, where CQ produced about 3.7 per cent (ABS, 2018) of Queensland mangoes. Two main mango producing region, Burdekin and Bundaberg, are close to the CQ region and hence the aggregated volume of mangoes in this region is very high. Australia produces about 3000 tonnes of lychees, mostly in central and northern Queensland. Recent communication with Australian Lychee Growers Association (ALGA. 2017) reveals that about 1,000 tonnes of lychees are produced annually in Rockhampton and Bundaberg region. Queensland is a major producer of several fresh vegetables in Australia including tomato, lettuces, capsicum, cabbages, broccoli, herbs and sweet potatoes. A substantial amount, about 4.5 thousand tonnes (Hort Innovation, 2016), of these vegetables are exported to South-East Asian and Middle East countries. Central Queensland also grows a small amount of herbs mostly for domestic consumption.

5.2 Air freights in Australia

Air transport provides better access to international markets, but the associated costs are very high. To export perishable commodities, air transportation is the preferable mode of transportation to preserve the freshness of the products. Several goods and products are exported from Australia by air freight (Table 3).

Table 3: Australian air export commodities

Commodity type	Value (AUD)	Weight (tonnes)	Share
Meat and meat preparations	944,230,137	95,087.0	17%
Vegetables and fruit	363,362,344	92,907.0	17%
Special transactions and commodities not classified according to kind	956,478,505	86,781.1	16%
Miscellaneous edible products and preparations	1,257,269,905	76,060.4	14%
Fish (excl. marine mammals) crustaceans, molluscs and aquatic invertebrates, and preparations thereof	1,046,824,713	28,283.2	5%

Noticeably, the major shares of air freights are perishable commodities. Among the other air freight products, gold, pharmaceutical products, mechanical and electronic equipment have a very high value (Commonwealth of Australia, 2018). Queensland holds about 15% share of Australian international airfreight, which is about 84 thousand tonnes (Figure 1).
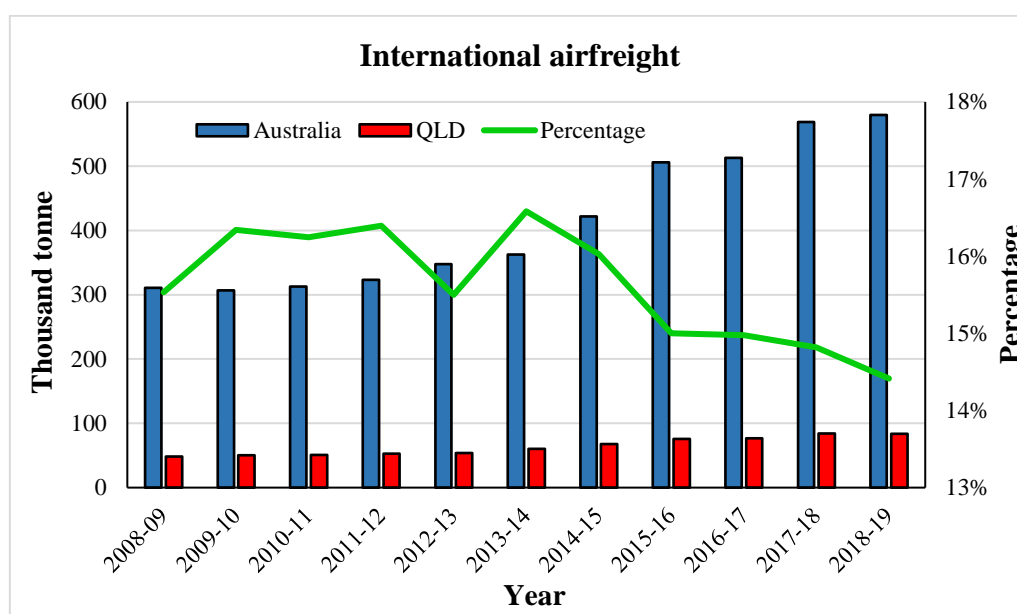

Figure 1: Volume of outbound international airfreight from Australia and Queensland (QLD)

(data source: BITRE, 2019)

Along with agriculture commodities, different goods are transported across Australia through domestic air freight. Over the last two decades, the trend of domestic airfreight has remained consistent, following a linear trend line with some occasional fluctuation (see Figure 2) (BITRE, 2018).
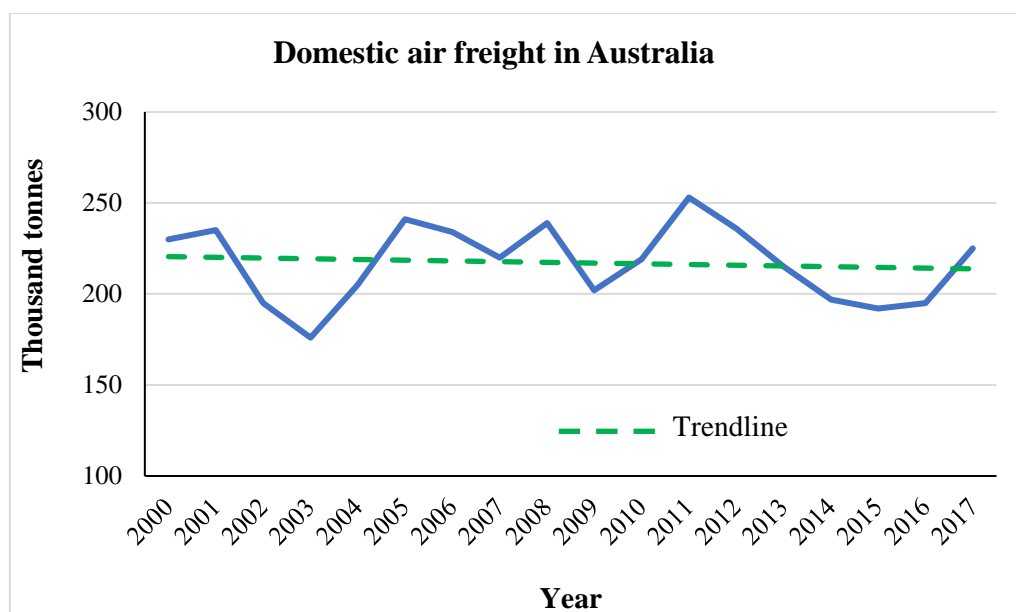
Domestic air freight in Australia

Figure 2: Volume of domestic airfreight in Australia (data source: BITRE, 2018)

5.3 Airports in central Queensland

Central Queensland has three regional airports, Rockhampton, Gladstone and Emerald. This section describes the existing air transport facilities in CQ and their suitability to be becoming an air-transport hub for exporting perishable commodities.

Rockhampton

Rockhampton has the biggest airport in central Queensland, located in the south-west perimeter of Rockhampton city with two runways that are respectively of 2568 metre and 1645 metres in length (RRC, 2017). The land area and the runway length of Rockhampton airport are suitable for upgrade to an international airport and as an export-oriented air-transport hub. Annual aircraft movement form Rockhampton airport is more than 10,000 movements per annum with some occasional international flights. In the recently released Rockhampton airport masterplan, the Rockhampton Regional Council indicates a commitment to exploring and developing air fright facilities to export agriculture and horticulture products internationally (RRC, 2017, pp 40). The council has identified three main challenges for diverting freight traffic from road to air freight facilities (RRC, 2017, pp 41), which are

- Transportation costs
- Journey time
- Available air network and aircraft serving that network.

The council have initiated several studies to investigate the extent of the international market for the agricultural products of CQ so that suitable aircraft operator and additional cargo facilities could be attracted in this region.

Gladstone

The Gladstone Airport is comparatively a smaller airport with high importance because of the Gladstone seaport. About 6000 aircraft movements per annum is recorded for this airport involving more than 300,000 passenger movements (BITRE, 2017). The sole runway of 1920 meter is long enough for medium scale cargo aircraft movements. The airport is located in the middle of the city and there is little vacant area for further extension (Table 4).

Emerald

The Emerald airport is an important regional airport in CQ because of its accessibility and connectivity to the local firms. The land size of this airport is approximately 198 hectares and it has potential extension capability to become an air-transport hub. The longer of two runways is 1900 meters and annual aircraft movements are more than 4500 per year (Table 4). Some small-scale cargo planes have operated from this airport to transfer locally grown products to the capital cities of different states of Australia. Table 4 summarises the basic features of these three airports and provides a better understanding of the potential of these airports for up-grade to air-transport hubs.

Table 4: Comparative features of regional airports in CQ

	Rockhampton	Emerald	Gladstone
Airport Location	Edge of the city	Edge of the city	Middle of the city
Airport size (approximate)	367 hectares	198 hectares	72 hectares
Runway numbers	2	2	1
Primary Runway length	2568 meter	1900 meter	1920 meter
Aircraft movement	10,002	4540	6148
Accessibility	High	High	Moderate
Extension capacity	Limited capacity	Limited capacity	None
Passenger movement annual	565,716	197,476	303,263
International flight movement	Occasionally	No	No
Cargo flight			
Aircraft acceptance	Boeing 747 to 776 and Airbus A340	Can be upgraded for Boeing 737	Boeing 737-800 / Airbus A320
Local agricultural business firm	1138	1175	442

5.4 Stakeholder's perception on developing airfreight hub in CQ

The research team organised a stakeholder workshop at CQUniversity to understand stakeholders' perceptions about the issues related to exporting perishable commodities of central Queensland. The 14 participants represented producers, local and state governments, agricultural peak bodies, agri-food processors and exporters, regional development representatives and researchers. The project team sought opinion through an open floor joint discussion on the viability of air transport hubs in CQ for regional agricultural supply chain development. At the end of the workshop, the project team also asked the stakeholders about future research issues.

During the workshop, the participants showed interest in knowing more about other high-value agricultural commodities that might be suitable for exporting the international markets. All participants agreed that central Queensland has a great road transport system with four national highways. A regional development expert mentioned that in spite of a fully functional seaport in Gladstone, local producers opted to send their product to Brisbane because of high shipment prices and/or delays in the Gladstone port. Participants also agreed that central Queensland

currently has no strategic infrastructure for air freight transportation and logistics.

One participant stressed that volumes of specific products are the crucial determinants to developing a air transport business hub for export to Asian markets. Information regarding the potential international clients is also important to predict the demand and the capacity of central Queensland to fulfil the demand. In addition, the participants also questioned the regional readiness in water management (for irrigation), as some other stakeholders considered this as a major issue of this region for producing perishable commodities. A primary producer added that the most important component for local producers is water supply through a developed irrigation system. The potential development of Rockwood weir has been discussed as it would enhance the water storage level of this region by about 76,000 mega-litres.

One of the development consultants thought that CQ has some advantages on developing a proper supply chain for perishable commodities to be exported in the Asian market. In his/her opinion Rockhampton airport has the advantages of potential cargo shipment where this airport can be upgraded to be a regional air-transport hub. One of the state government officers added two more advantages i.e., the sustainability of local production and availability of skilled labour force in the CQ region.

A local government officer emphasised the current level of government support for developing a perishable commodities business hub in this region, which was supported by several participants. A horticulture producer agreed with the idea of having proper processing infrastructure in this region and that there should be some interactions among the local producers and government bodies both at local and state government levels.

A regional development expert believed that agricultural education (vocational training) and research are also essential to advance the perishable commodities industry. Local government should also increase employment opportunities in this sector to involve the skilled workforce. A horticultural expert thought that market intelligence should be practised with some flexibility in the dynamics between producers, processors, distributors and exporters.

The project team asked the participants to discuss the immediate and medium or long-term requirements to promote CQ's perishable commodities. One local government officer assumed that the cold storage development is one of the immediate requirements for the perishable commodities. In terms of long-term requirements, one local government officer thought that land availability will be a key issue for developing processing to support the perishable commodity industries. Workshop participants agreed that the local council should engage and contribute to developing an air-transport hub and cold storage facilities. The participants acknowledged the insufficiency of the production volumes of CQ's agricultural commodities (excluding beef) compared to the international market demand. The development of air transport hub in this region should be combined with the improvement of enabling infrastructure. The international market access can be achieved by developing an intermodal network to export the perishable commodities of central Queensland.

6. DISCUSSION AND CONCLUSION

Central Queensland has a major agricultural sector which is capable of increasing production to match demand for perishable commodities in some Asian countries. Processing and transportation are the two of most important forward linkages in the supply chain for exporting perishable commodities. CQ region has a strong road transportation infrastructure and some developed processing industries including beef and pineapples. However, this region is lacking an air transportation hub which is pivotal in exporting perishable commodities.

There are some limitations to CQ developing a consistent supply chain for perishable commodities. One of the main impediments is the lack of water supply to expand production close to the Rockhampton airport. Another impediment is the lack of transport options for

perishable commodities. While there are three regional airports in central Queensland; however, none of them is operating international cargo flights.

Secondary data analysis and a stakeholder workshop revealed that beef, pineapple, mangos and lychee have the most potential for export development into targeted Asian markets. The current study also finds that the Rockhampton airport has the potential to become an air transport hub While the Emerald airport has the advantage of accessibility to a productive agricultural region, the existing runway is not suitable for larger cargo flights and the scope for potential expansion is limited.

The current study recommends several actions for further development of intensive agriculture in the CQ region. First the production of perishable commodities needs to increase to achieve the scale required for export volumes; this will require increased access to resources such as water. Second, there should be gradual development of air transport facilities in parallel with growth in production and international market access. Relevant stakeholders including representatives from local and state government need to be engaged in the development of an air transport hub. Coordination and accumulation of supply between regions to achieve export scale, together with a network of transport options, may be required in the shorter term until a fully functional air transportation hub is established in this region.

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Spatial and Temporal Contexts of Changes in Median House Prices in Australian Metropolitan Cities: A Case Study of the West of Melbourne

Zillur Rahman[1], Yogi Vidyattama[2], Delwar Akbar[1], John Rolfe[1]

[1] Central Queensland University

[2] University of Canberra

Email: z.rahman@cqu.edu.au

Abstract

The median house prices in Australia have been rising faster than disposable income over the last decade, especially in the metropolitan capital cities. Nevertheless, the house price and its growth have been varied considerably across locations in these metropolitan cities. This study examines the spatial and temporal variations in median house prices in metropolitan cities through a case study of the west of Melbourne city. This study used quantitative methodology supported by the geographic information system (GIS). This study found the different median house price clusters with a significant relationship to public amenities such as hospital locations, access to the workplace, access to shopping, access to medical facilities and public transport terminals. The distance from CBD (Central Business District) also played an essential role in the price increase. These findings have implications for future urban planning in Melbourne.

Keywords: Housing, high-high and low-low clustering, Univariate Local Moran I, urban, Australia

1. INTRODUCTION

Australian housing is becoming increasingly high-priced (Kupke and Rossini, 2011). House is necessary for realising the simple necessities of people; it gives refuge and most of their day by day things to do in the locality. People began spending a large percentage of their income for housing (Aitken et al. 2019; Kutty 2005 Martel, Whitzman, and Sheko 2019). One of the key elements that drive the rapid median house price change is the population increase in the metropolitan cities, usually by means of migration. Housing development sector can now not cope with the population growth as well as the long lagging time between development application and house construction. Digital Finance Analytics (2019) calculated the variety of households living in heavily crowded houses in major cities has doubled in 15 years, accounting for much of the overall increase in housing stress. In 2001, this group accounted for 35% of people living with a family, with 31% residing in cities. Concentrations of households rose to 44% in 2016, with concentrations in large cities (Digital Finance Analytics 2019). Nevertheless, there is nonetheless a trend towards lower flat incomes, higher living costs and higher real mortgage rates.

Rapid changes in median house price affect the housing of the low and medium-income people in every metropolitan city in Australia. Bullen and Baldry (2019) and Kupke and Rossini (2011) illustrated many factors that affect the supply, demand and cost of housing across Australia. Again, Digital Finance Analytics (2019) demonstrated that 37% of all households indicated that regular household expenses were met. House costs have typically risen at a rate similar to that of household incomes until relatively recently. This is consistent with price patterns, among other necessities, such as personal transportation, food and clothing. In some metropolitan markets, house prices have doubled, tripled, or even quadrupled compared to household income.

However, housing prices are generally considered and measured with regard to access to community amenities where the housing is located and regardless of the ecological, social and economic stability of the location (Mulliner and Maliene 2011). Again, Mulliner and Maliene (2012) noted that the cost of housing is not just about cheap and decent housing. Still, a more comprehensive range of factors, such as access to housing amenities and the neighbourhoods where it is located, need to be taken into account.

Accessibility of housing in all significant markets remains extremely elusive in Australia, with substantial margins in Sydney and Melbourne. Digital Finance Analytics (2019) and Daley, Coates, and Wiltshire (2018: 3) described in all major markets for Australia, availability of housing remains exceptionally challenging, and a large margin in especially in Melbourne. Today, the house prices are more than double the income level of the early 1980s. Again McGreevy (2018) and Daley, Coates, and Wiltshire (2018) contended the median-income households in Sydney and Melbourne have to pay for the median-priced house for at least three years more income than they did in 2004. The paper examines spatial and temporal contexts of median house price changes in Australian major metropolitan cities through a case study of the west of Melbourne. The main focuses are house price changes over time, examining trends, patterns, paths and access to services through a case study of the west of Melbourne, which consists of Maribyrnong, Brimbank and Wyndham LGAs. The paper examines spatial and temporal contexts of median house price changes in Australian major metropolitan cities through a case study of the west of Melbourne. The focuses are house price changes over time, examining trends, patterns, paths and access to services through a case study of the west of Melbourne, which consists of Maribyrnong, Brimbank and Wyndham LGAs.

The study includes an introduction to section 1.0; section 2.0 literature review, accompanied by section 3.0 methodology and methods. Section 4.0 includes temporal and spatial analysis of average house prices, and finally, section 5.0 and section 6.0 explain the clustering of median house prices and the conclusion.

2. LITERATURE REVIEW

Housing plays a dynamic role in addressing micro-level issues such as community attitudes, job opportunities, network conditions, access to high-quality public services (such as schools and health care facilities), employment, leisure and recreational opportunities, and accessibility of facilities services. (Glaeser, Gyourko, and Saks 2005; Albouy and Ehrlich 2018; Glaeser and Gyourko 2018; Ismail and Shaari 2019). Fik, Ling, and Mulligan (2003) described, locational features are capitalised into the median house price combining locational variables with other structural attributes. These structural attributes are such as schools, road networks, parks, service centres, workplace and distance from the CBD show recognisable spatial patterns.

Once again, Fik, Ling, and Mulligan (2003) found the location attributes of a property is much harder to observe and quantify as numerous external effects act on a particular location. Goodman and Thibodeau (1997) have, therefore implemented housing clusters for price trends and directions using a modelling approach of boundary hierarchy. The hierarchical model assumes that all houses in a spatially clustered area share facilities linked to the location of the house. As a result, the housing characteristics that decide the market value of a property are rooted in a hierarchy — neighbourhood properties, neighbourhoods access to shopping centres, transportation network, workplace access, school, parks, banks, hospitals, distance within cities, and so on. By contrasting the predictive accuracy of their hierarchical system for submarket determination with the predictive accuracy of hedonic models using postal codes and census tracts for submarkets.

In addition to being dictated by market conditions of supply and demand, accessibility of small and medium house prices are also crucially dependent on conditions in neighbouring housing markets. The ratio of house prices to annual salaries, alternative location measures, taking into account both distance and time to the Central Business District (CBD) and inaccessibility adjustments (Ottensmann, Payton, and Man 2008; Fingleton, Fuerst, and Szumilo 2019). So, housing markets are increasingly priced in proximity to CBD and residential housing, transportation, facilities and services. So that house prices in Australian cities are now following a classic tender curve, with significantly higher downtown prices and much lower prices on the rapidly developing fringe.

Housing price has a significant impact on the economy of Australia and people's welfare. Wage growth does not increase in the same way as Australia's impacted rise in house prices in the current years (from 2006 to 2016). Therefore, home buying and renting, predominantly in capital cities, is now meaningfully more difficult than earlier (Victoria Parliamentary Report 2019). When considering Melbourne in Victoria, the suburbs of the East of Melbourne shows the least affordable houses with access to amenity measures decreasing further towards the west. However, the west of the suburbs had the highest housing prices to higher in low-income household expenses, indicating that households in those areas may be suffering notable points of housing strain (Bryant 2017). Kupke and Rossini (2011) stated that a single income household on a moderate income in Melbourne in 2001, can afford a house in the outer edge, which was 25 kilometres from the city centre. So, regarding this context, it is now beyond expectation for the low-income household to afford a house even though, it is the border or closer to the perimeter of the Metro Melbourne (Bruce and Kelly 2013; Abelson 2016).

In Australia, median housing prices have become a severe concern for single-income households and young homeowners. It is becoming a key focus for politicians as house prices are rising exponentially, becoming more antagonistic to the public and Australia's government. (Pettit, Tice, and Randolph 2017; AURIN 2019). Housing prices focused heavily on the interplay between housing markets and the economy because the house is a financial asset that has a direct connection with a country's economy (Villanueva et al. 2019; Yap, Yong, and Skitmore 2019). It also depends on housing supply and demand in the society. House price growth is a phenomenon that is typically defined by a rapid increase in market prices until they reach unsustainable income or rent rates and then drop.

In comparison to income and rent in the late 1990s and early 2000s, Australian house prices rose sharply; however, both the price-to-income ratio and the price-to-rent ratio remained relatively constant between 2003 and 2012, with house prices matching income and rent growth over the decade. In terms of wages and rentals, prices have again risen sharply since 2012 (Kendall and Tulip 2018; Hulse and Reynolds 2018). Nowadays, the

price differs in the suburbs due to increased availability of credit due to financial deregulation, low-interest rates. Since 2008, restricted release of new land by the state, policy restrictions on land use preventing higher density of land use, state limitations on the usage of green fields to promote urban densification, rapid population growth due to migration and first levies imposed by local councils in the early 2000s (Hulse and Reynolds 2018). In capital cities, the average house price now amounts to more than seven years of average earnings.

In brief, from the above descriptions, it is clear that locational features are capitalised into the median house price integrating variable location with other structural attributes. Such structural elements contribute to the development of housing clusters with a modelling method of boundary hierarchy for price trends and directions. Housing markets are rapidly located on the fast-growing fringe in comparison to CBD and much lower prices. In this sense, the East of Melbourne suburbs, when comparing Melbourne in Victoria, demonstrate the very high experiences of median house prices with access to amenity initiatives further decreasing westward. When house prices rise exponentially, becoming more confrontational to the public and the government of Australia, it becomes a key focus for politicians. Housing prices focused heavily on the interplay between housing markets and the economy as the house is a financial asset that has a direct link to the economy of a country. It also relies on society's supply of housing and demand.

Most studies were conducted on the price or ratio method of income-to-housing and structural expenditure to reflect on the access to facilities of the place context-residual expenditure. This research would find that GIS-supported software is more important for analysis to measure the prediction of spatial and temporal shifts in median house price distributions. The specifics of the households available in the dataset, this study focused on the following: which are considered to have marketing value of median house prices due to the growth of different census years. The datasets are the initial amount of median house prices, average annual income, annual mortgage, annual average lease per medium household and the closest distance from the average house prices. This will allow a case study in the west of Melbourne to explore trends, patterns, routes and access to services.

3. METHODOLOGY AND METHODS

According to Baker, Mason, and Bentley (2015:276), when household income in Australia spends 30 per cent on housing, it is perceived to be housing stress. Saberi et al. (2017b: 136), said a high cost that is overlooked in assessing a locations' value of usability. In this paper, it presents a modelling approach, motivated by Land Channel Victoria's free and open spatial data (Vicmap 2019), to quantify local access to affordable housing facilities integrates the cost of living (Australian Statistics Bureau 2019). This paper will explain that research into the median price of housing, which has to take into account the spatial and temporal variation in different housing markets. Today, housing tends to focus on three 2006, 2011 and 2016 census years to highlight researchers ' data reality, rather than admitting to giving the most prominent obstacle.

Results will be evaluated by taking into account three suburbs of LGA's (Maribyrnong, Brimbank and Wyndham, Fig. 1.1), and surrounding suburbs. Tend to be accessible to housing prices is not reasonable in terms of hospital locations, transportation system, mortgage payments, annual income, access to work and population distribution (Kowaltowski et al. 2019). The variables of housing and the parameters of accessibility facilities are taken into account in a correlation study. It also took into account the presence of spatial clustering

outliers extensively in the study areas in the accessibility of amenity measures. The paper's methodological input is the inclusion of extensive services related to accessible measures to median house prices and living expenses that contribute to a better understanding of local access to standards of living. The new structure would make a significant difference between living costs after the cost of housing and desirable location attributes. Results will show that housing pricing policies and plans should be made in harmonisation with hospital locations, transportation system, mortgage payments, annual income and population distribution, social and environmental suitability, commercial infrastructure to ensure efficient and fair results. According to Anselin (2013) and Vidyattama et al. (2019a), the regional Moran Index's importance distinguishes local clusters and local spatial outliers based on an expert technique of variation that is somewhat sensitive to variation factors.

Fig 1.1: Study area

In spatial mapping, different colours used to identify different groups of concentration with values of strength of amenities (ESRI-ArcGis 2019; Anselin 2019b). Anselin (2019a), again stated that the Moran scatters plot has four categories of spatial associations, concerning location and points in the map. Such four classes are referred to as ' medium, low-low, low-high, high-low, relative to the average ' (Anselin 2019a: 4). From the analysis, Anselin (2019a: 5) signifies A cluster map with ' locations showing the form of spatial association, based on the critical site and its spatial delay in the Moran scatter plot '. Four types of clusters are characterised ' with high-high dark red, low-low dark blue, low-high spatial outliers light blue, and high-low spatial outliers light red' (Anselin 2019a: 5). The clustering alliance and its significance can enable us to identify the locations and directions of the local Moran index with the utmost attention (Saberi et al. 2017b). According to Anselin (2019a) and Saberi et al. (2017b), the group one represents in colour red is the suburbs of high value of median housing prices and locational accessibility attributes with similar surrounding suburbs. These will be the High-High or expensive suburbs and are spatially concentrated with high median costs. In dark blue characterises the group two, the low-low signification between median housing costs and locational importances of housing measures. These suburbs are representing suburbs with

lower values of access to affordability standards accompanying with comparable suburbs with lower access to attributes. Such suburbs pay special attention to the optimistic of the Local Moran index. Group three, light blue, reflects the suburbs with moderate to higher exposure to housing initiatives relative to median house prices for the low-high spatial outliers. Finally, group four, light red for the high-low spatial outliers are high median house prices, but for some reasons, house prices are becoming low due to fewer incentives to accessibility steps. The cluster examination contributes to the selection of suburbs, notably occupied over time and location, and comparable access to housing affordability characteristics with closest suburbs.

The data was collected from Land Channel Victoria - Vicmap, ABS and suburb profile of Australia. In the data, it has shown house prices in three census years as a temporary basis. The data analysis is going describe from 2006 to 2016, where there is a variation of median house prices by its location and the context of amenities location. This data is going to analyse in four different ways as classification, prediction, association, clustering and data visualisation (Anderson and Shaw 1999; Rittichainuwat and Rattanaphinanchai 2015; Koutsogiannopoulos 2018; Desai 2015; Mashima et al. 2018; Yu 1977). This paper is using the predictive method – through the spatial-temporal basis for median housing Price to analyse in Univariate Local Moran's I and Regression. The following sections will present the data analysis descriptions with the variation prices of different suburbs.

3.1. Data Classification by spatial and temporal basis concerning housing cost to income and living cost to income

Data classification in this research represents several stages. Data classification is delegated in quantitative analysis informing techniques that are implemented in a multi-level conceptual framework of data mining and knowledge visualisation of large data sets with a comment on definitions and descriptions of large data sets. Qualitative and quantitative methods are therefore integrated with the design, methods, interpretation and reporting of the study (O'Halloran et al. 2018; Mashima et al. 2018). Classification is the starting activity in this quantitative analysis by using ArcGIS. Initially, data collected from different sources of 42 suburbs of three city councils (study areas) and adjacent councils which are having conventional boundaries with the research areas and attached with the study LGAs with different groups. After collecting, there were categorising the data of 42 suburbs by:

1   The average income of the family

2   Annual mortgage by the household

3   Dwelling sizes of the area (3 Bedroom houses)

4   Annual rents by average households

5   The population of the suburbs (in three census years)

6   Median house prices (in three census years)

7   Growths of median house prices (in three census years)

8   Nearest distance to amenities from the median houses.

(discover.data.vic.gov.au –address point data and Australian Bureau of Statistics (ABS), Suburb profile of Corelogic Data).

3.2 Prediction by the spatial-temporal basis for housing cost to income and living cost to income

After different categories of data, the median house prices in the study area, in general, is

analysed and compared to other areas in Melbourne. From the above descriptions, the study was considering the classification of the data from section 3.1.1. The study focused on the following household datasets. These are considered to have marketing value of median house prices by the growth of different census years, and the growth of prices and initial cost of median house prices, average annual income, annual mortgage, annual average rent per median houses and nearest distance from the amenities of the community (Yu 1977; Anderson and Shaw 1999; Singh and O'Brien 2018). Compare median house price to average, and the growth is considered 2006 is the base year for analysis (map fig-1). The distributions of median house prices are more crucial to analyse. The following maps are the interpreted data shows the distribution of prices in different suburbs in different census years in western Melbourne LGAs.

Housing focuses on the cost of housing and its household income affiliation as the only accessibility factor (Bogdon and Can 1997; Burnley, Murphy, and Jenner 1997; Gabriel et al. 2005; Liu et al. 2014; Hamidi, Ewing, and Renne 2016). The provider of the mortgage in Australia for a home loan is "the Australian Financial Security Authority (AFSA)" is an independent Australian government body that acts as Australia's homebuyers granting the housing loan that encourages to seek financial advice for further understanding (AFSA 2016).

Housing Accessibility Index (HAI) is for new regional and metropolitan single-family homes (Hamidi, Ewing, and Renne 2016: 436). The AFSA's accessibility index tests whether a typical family would qualify on an average house for a mortgage loan. An index above 100 means that a family earning a median income has more than enough income to be eligible for a medium-priced household mortgage loan. Assuming a 20% down payment, whereas an index value below 100 means that a family cannot afford a medium-priced household (Hamidi, Ewing, and Renne 2016: 436). The housing property may include:

- house
- apartment
- land
- farm or business premises.

The loan authorities, i.e., the trustee determines how to deal with the property. They may investigate:

- the value of the house
- how much the occupiers owe to creditors
- what the creditors' intentions are with the property
- the number of co-owners and their intentions.

In many metropolitan cities, housing zones with some newly developed facilities are becoming excessive (Yates, Milligan et al. 2007, Arafat 2011, Bailey 2016, Randolph 2017), causing trade-offs between housing and regional employment and service quality (Martinez, Navarrete et al. 2004). This paper analysed the median house prices in the LGAs of Brimbank, Maribyrnong and Wyndham in terms of spatial and temporal differences from 2006 to 2016.

With the above, median house prices distribution and growth for western Melbourne district are given below in comparison with greater Melbourne metropolitan.

4.   TEMPORAL AND SPATIAL CONSIDERATION OF MEDIAN HOUSE PRICES

4.1 Spatial median house prices distribution and growth – compare to Average – 2006

These are the analysed data for Melbourne metropolitan and the study area. At this stage, median house prices data from 2005 to 2016 were collected and analysed to see the results for three census years of 2006, 2011 and 2016. In the map (Fig. 2.1), the median house prices distributions are represented. The data reveals that the study area is experiencing lower median house prices for most of the suburbs in comparison to the rest of the greater Melbourne.

Fig. 2.1 also shows the variations of median house prices among 2006, 2011, and 2016 census years. Three maps of the study areas show changes in median house price sales. In the year 2016 show the house price increased at a higher rate than are close to the city of Melbourne CBD.

Overall, the median house prices of the east of Melbourne suburbs are more than the west of metro Melbourne LGA. In the map (Fig 2.1) reveals that the three LGAs in the study area experiences low median house prices for the census year 2006. However, the median house prices among the suburbs were identified in five different categories as 0$ $200,000, 200,000-$300,000, $300,000-350,000, and $350,000 - $400,000, and above $400,000.

Among all the suburbs, the Wyndhamvale was the lowest median house prices. There were differences in median house prices by suburbs among three LGAs (Study areas). Maribyrnong is the LGA, located close by the Melbourne CBD (the distance around 6 km from CBD) is having the highest median house prices in 2006 census year. At the same census year, some of the suburbs in the Brimbank LGA experienced $200,000 to $300,000 median house prices. None of the suburbs had median house prices less than $200,000, but Derrimut and Keilor found the expensive suburbs where the median house prices were $350,000 to $400,000. In the Wyndham LGA, none of the suburbs had more than $350,000 median prices houses.
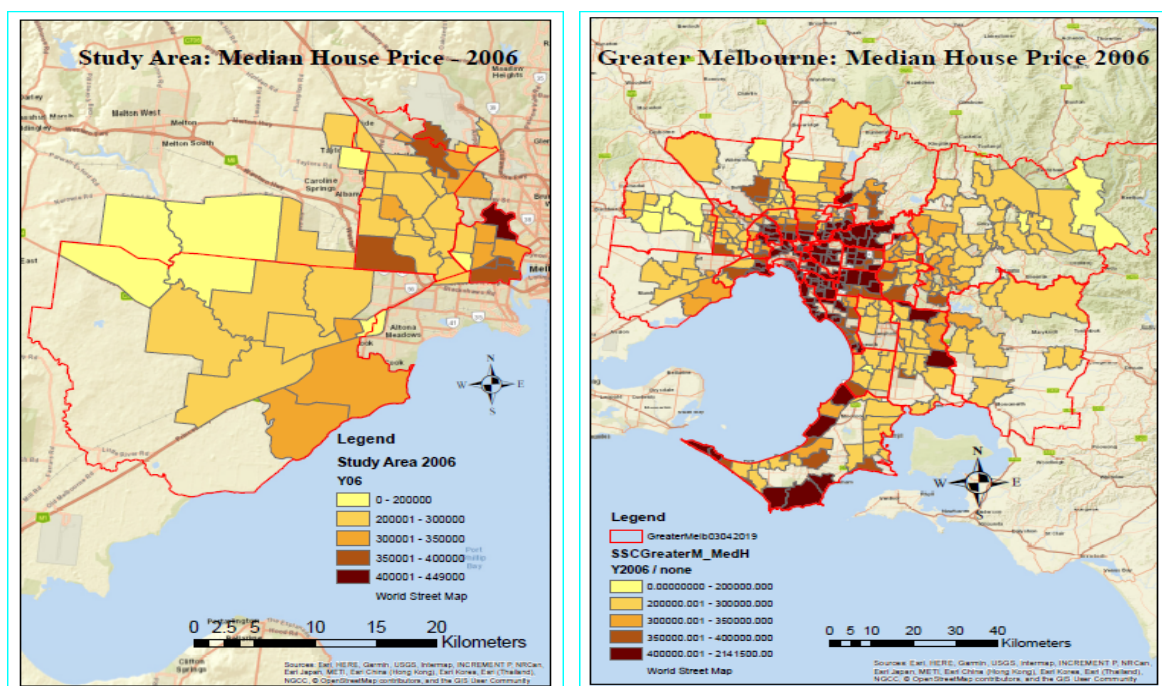

Figure 2.1: Distribution of median house prices Study area in comparison to Greater Melbourne.

When considering the Maribyrnong LGA, only Tottenham had lower median house price, because earlier it was considering as industrial suburbs and there were fewer houses. Except for Tottenham, all other suburbs had increased median house prices. The Braybrook had the lowest median house price, but still above $300,000. The suburb, Maribyrnong had the median house prices matching with the CBD and most the eastern suburbs metro Melbourne (more than $450,000).

Same as median house prices distribution among the suburbs of the study area, the growth also shows local differences in percentage form for the census year 2006 (Fig 2.2). Spatially, the differences had shown the analysed data by the suburbs and comparing to the eastern metro Melbourne LGAs. As there were 42 suburbs data were found for the analysis,
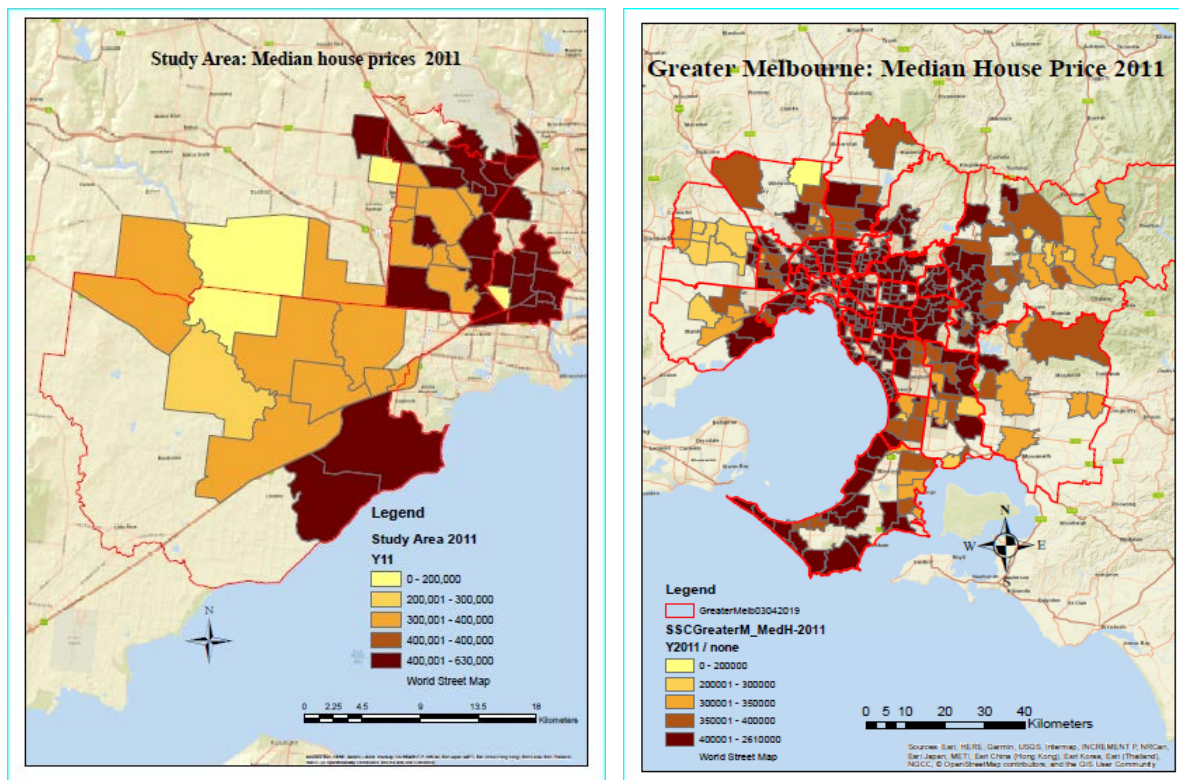

Fig 2.2: Compare Median House Price 2011 in study area concerning greater Melbourne

In the map, 2.2 it shows that greater Melbourne has the increasing house price with increasing rate. The study areas are lagging behind the increase in house price for more significant Melbourne areas. Eastern suburbs are the worst heating area for with the increase of house price.

From fig 2.3, it represents that the changes in price also higher lower to the rest of Melbourne. Study areas are lowest in a median house price increase from 2006 to 2011, but still, the increasing rate is beyond the capacity of lower-income groups.
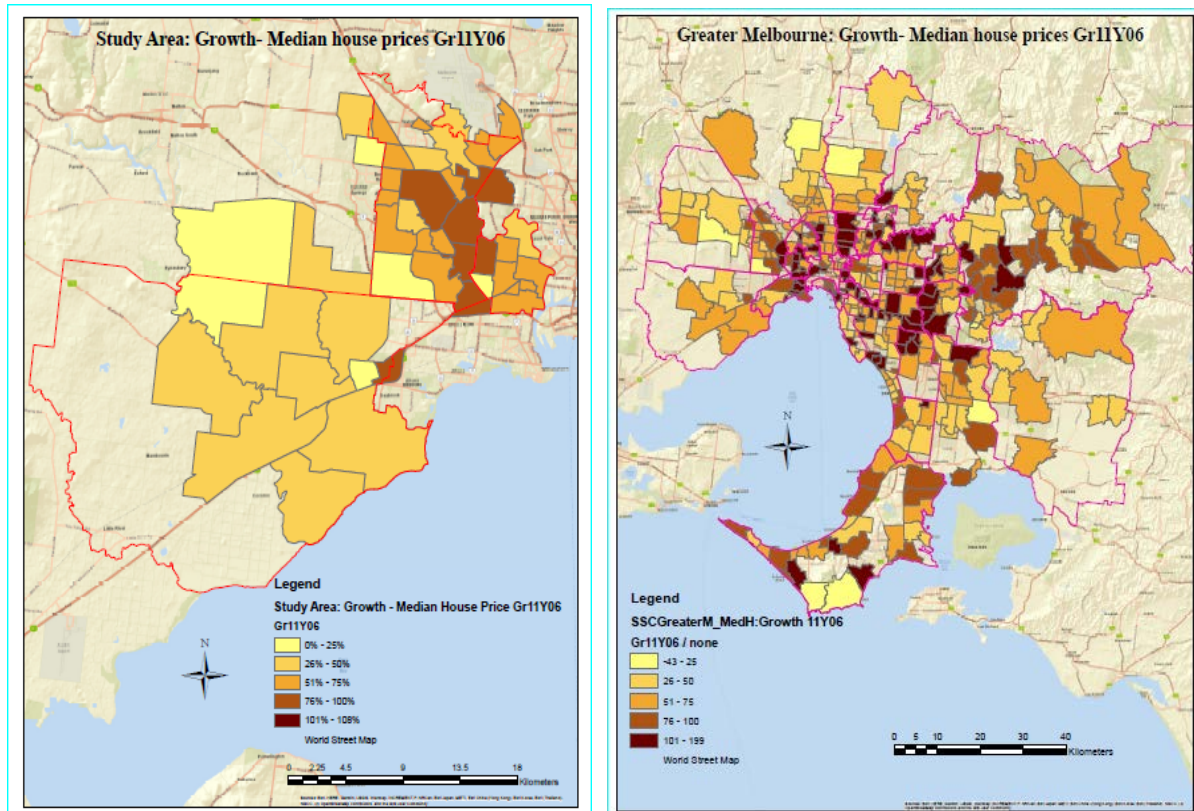
Fig 2.3: Changes in Median House price from 2006 to 2011

4.2 Compare Median House Price 2016

Map in fig 2.4, is another sign of house prices sky-rocketed in Melbourne city. Almost every suburbs experiences higher median house price in the census year 2016. Approximately all of the suburbs have more than 400,000$ median house prices in Melbourne in 2016 census year. Very few of the suburbs show lower median house prices, but either they have located the edge of the Melbourne metro boundary or further away from the CBD.
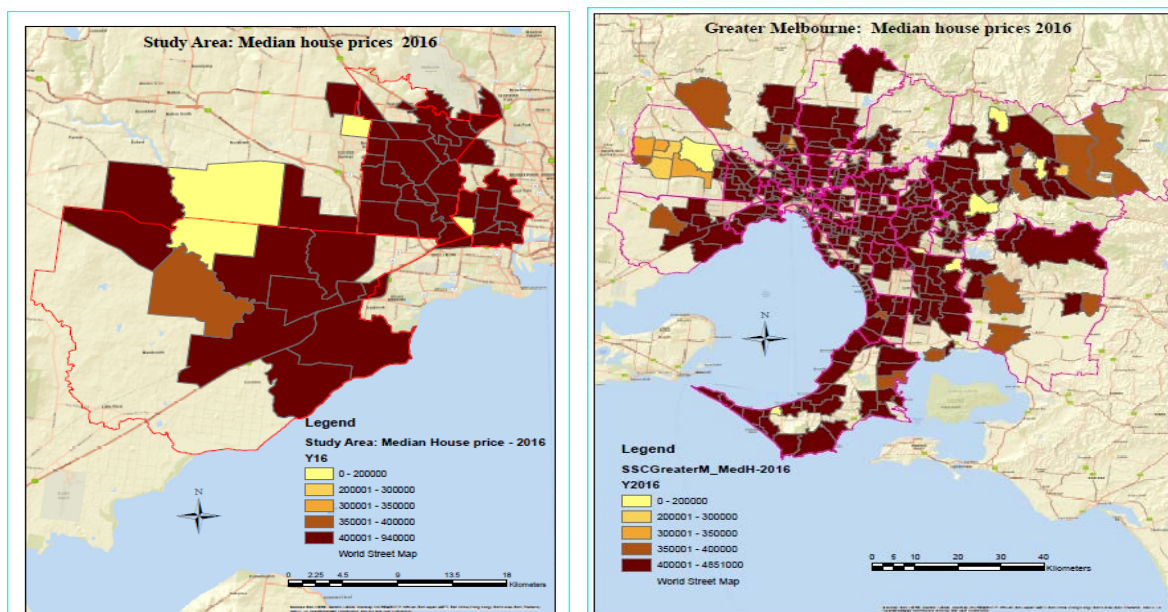

Fig 2.4: Distribution of Median House Price 2016

While comparison with the changing rate of house prices from 2011 to 2016, it was found the increasing rate was not as much as it was experienced in 2006 to 2011. The expanding rate of median house prices was ranging from a maximum of 60% in different suburbs. In these census years from 2011 to 2016, most of the median house prices increased by 15 to 25%. The suburbs located close to the CBD experienced higher changes of price, especially the suburbs of Maribyrnong.
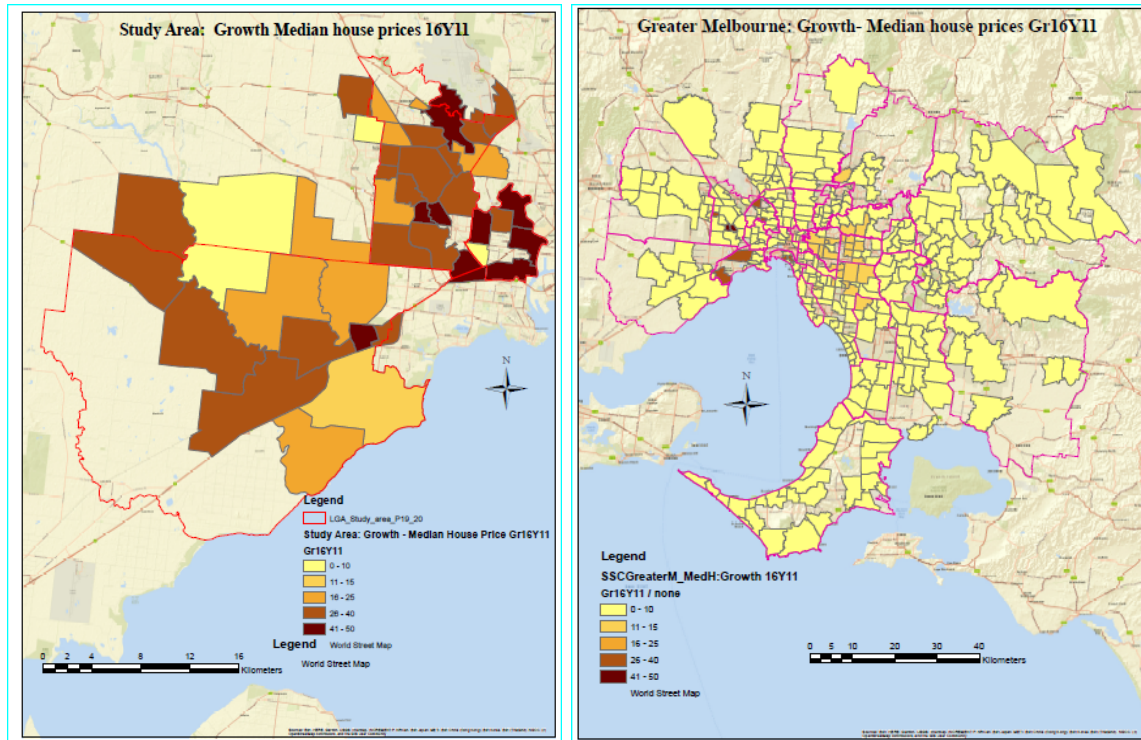

Fig 2.5: Changes in Price from 2011 to 2016

The median house price intensely increased from 2006 to 2016. Median house price increased 250% in Melbourne metropolitan, and the study areas jumped to 140% (fig 2.5).
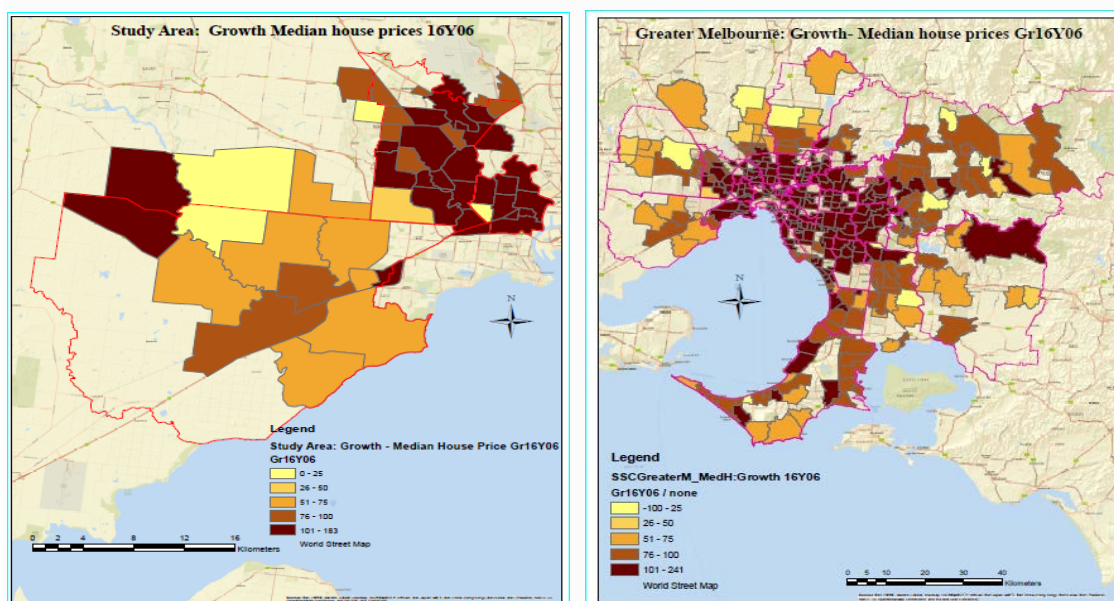

Fig 2.6: Changes in median Price from 2006 to 2016

Melbourne metro has the most significant increase in median house prices. The study areas still have suburbs where the changes in median house price were lower to 25%. In 2016 census year it has observed the Brimbank's suburbs are going along with the Maribyrnong LGA suburbs. Brimbank became expensive now than before. The Brimbank suburbs were comparatively cheaper in 2006 and also in 2011 (Please see fig 2.1 and 2.2).

5. CLUSTERING

Univariate Local Moran I, clustering and regressions were conducted to show Whether there is clustering in the median house price and access to services. Suburbs in the study areas for the different census years show that there is positive Moran's index of spatial auto-correlations for several suburbs. In the census year 2006, it found that only Maribyrnong LGA (Fig 2.6).

According to Anselin, Syabri, and Kho (2006), Anselin (2019a) and Vidyattama et al. (2019), the importance of the local Moran Index statistics are based on a spatial association is somewhat sensitive to the median house prices based on the suburbs location value and its spatial lags and showed in High-High or hot median house prices or costs in dark red (Fig 2.6). Here from the median house prices, it has observed considerable changes for higher rates. Fig. 2.6 shows the LISA cluster in median house price suburbs allocated for housing, access to attributes is high in only two suburbs in Maribyrnong LGA in 2006 census years whereas, fig. 2.7 displays the associated LISA meaning of clusters level for High_High median house prices changes to three suburbs, and it includes one suburb from Brimbank. Saberi et al. (2017b) and Anselin (2019a) stated that the clustering of High-High and Low-Low makes it conceivable to select which suburbs are causative most strongly access to the median house prices and accessibility measures to the local Moran's Index and its directions (Fig 2.6 and 2.7).

Fig 2.7 Median House price Cluster map; the Census year 2006.

Map 2.7, 2.8 and 2.9 prove four groups in the LISA cluster maps with High-High (dark red), Low-Low (dark blue), Low-High (light blue) and High-Low (light red) as shown in 7 to Fig 2.9. The group one represents suburbs with a high value of median house prices. This can be representing inaccessibility for low-income households of the Melbourne city. The high accessibility of services of housing with similar surrounding suburbs in dark red colour serves high-high or hot suburbs. These clusters are situated within the Maribyrnong LGA for the census year 2006. These locations are comparatively closer to the Melbourne CBD and are spatially concentrated. Group two of suburbs represent the Low-Low in dark blue (fig 2.7 and 2.8) association between

median housing prices and access to housing affordability measures. These suburbs are concentrated in the western part of study areas representing areas with low median house prices, or lower costs might be representing lower access to housing affordability attributes; influence toward the positive local Moran's index (Saberi et al. 2017b). The light blue and light red colour in 2.7, 2.8 and 2.9, represent the group three and group four. Both groups show suburbs that are possible "spatial outliers" influencing toward negative local Moran index. The suburbs of higher median house prices of lower access to affordability attributes associated with suburbs with lower median house prices with potentially higher access to housing amenity measures.

From fig 2.7, it is observed that only one suburb in the Brimbank and two suburbs in the Wyndham city councils are having low-low clustering for the median house price increases. Table 1 shows that there were signification relations in the amenities locations and access with the median house prices from 2006 to 2011.

Table 1 analysed, the study areas conducted the locations of several services/amenities with the nearest distance of suburbs. The parameters considered for this study were:

- Median house prices (in three census years)
- Nearest distance to amenities from the houses as:
  - Educational institute (Schools, Colleges and Universities)
  - Parks
  - Hospitals
  - Public transport Victoria, the bust stops
  - Public transport Victoria Train station (Metro or V-line)
  - Industrial location (Workplace)
  - Waterbodies (Sea beach, lakes or creeks)
  - Commercials
  - CBD
  - Time distance from CBD by bus
  - Time distance from CBD by Train

(discover.data.vic.gov.au –address point data and Australian Bureau of Statistics (ABS)
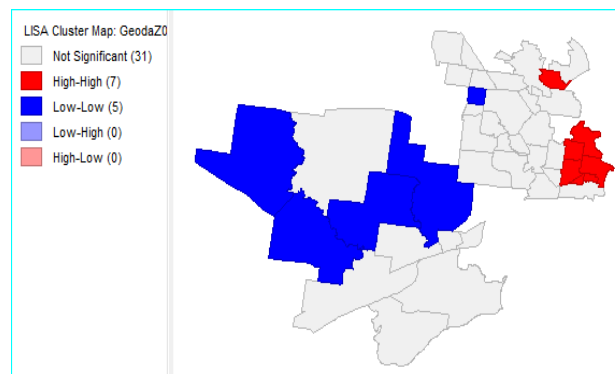

Fig 2.8: Median House price Cluster map; the Census year 2011

Figure 2.8 in the 2011 census year offers dramatically in the maps of housing prices to the LISA clusters. The LISA cluster maps for the median house price, as shown in figures 2.6 to 2.8, indicate that suburbs Low-Low clusters are mostly clustered in the Wyndham LGA on the outer edge of Melbourne's west and further away from the CBD. Nevertheless, the median home price cluster warm suburbs are located near the Melbourne CBD. It reinforces the finding that the median housing price is the highest to the closest CBD range suburbs and the lowest to the edges of the city. However, the LISA cluster maps of housing, shown in figs 2.8 and 2.9, reveal the different picture. Hot suburbs are located close to Melbourne, while Low-Low or cold cluster suburbs are located on the CBD outskirts or boundary. A complete picture that combines the spatial patterns reveal the median housing prices and access to housing affordability measures can be understood from the figures 2.6, 2.8, and 2.9. These findings support the median housing prices and access to amenity measures are highest in the closer to the CBD and lowest in the outer periphery or edge areas of the CBD.
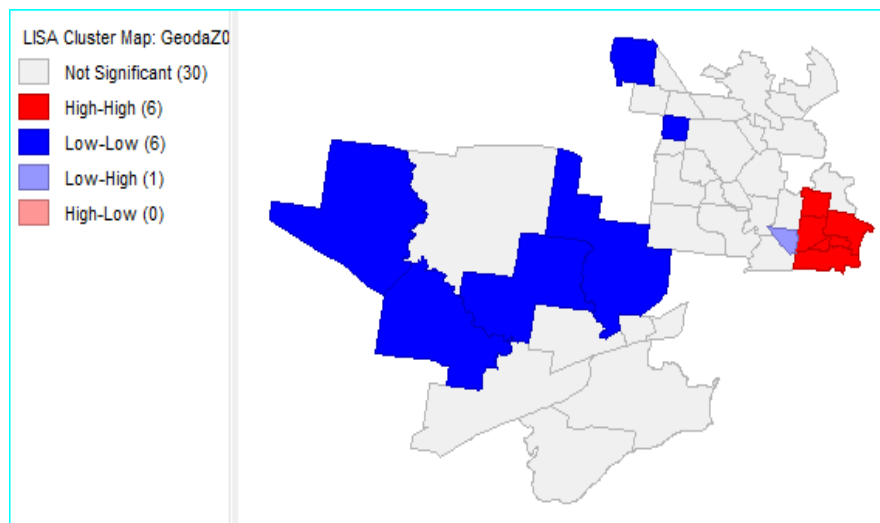

Fig 2.9: Median House price Cluster map; the Census year 2016

After doing calculations through ArcGis and Geo-da data mining software, the predictions came up as there are significant relationships in hospital locations and PTV bus stops (Fig 2.7). The results show that distance from CBD is a significant factor as usual for every city of the world.

Table 1: Changes of median house price from 2006 to 2011 concerning amenities

```
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set             :  GeodaZ070519
Dependent Variable   :     Gr11Y06  Number of Observations:   43
Mean dependent var   :     53.0622  Number of Variables   :   12
S.D. dependent var   :     24.0767  Degrees of Freedom    :   31

R-squared            :    0.537613  F-statistic           :      3.27667
Adjusted R-squared   :    0.373540  Prob(F-statistic)     :   0.00450799
Sum squared residual:     11525.7   Log likelihood        :     -181.224
Sigma-square         :     371.796  Akaike info criterion :      386.447
S.E. of regression   :      19.282  Schwarz criterion     :      407.582
Sigma-square ML      :     268.039
S.E of regression ML:      16.3719

-----------------------------------------------------------------------
      Variable    Coefficient     Std.Error     t-Statistic   Probability
-----------------------------------------------------------------------
      CONSTANT       38.0305        16.6565        2.28323       0.02943
        ND_edu   -0.000125261    0.00027234      -0.459943      0.64877
       ND_Park   -0.00450042      0.0045003       -1.00003      0.32504
       ND_Hosp    0.00353436     0.00130266        2.71319      0.01078
       ND_PTVB     0.0127266     0.00545432         2.3333      0.02629
      ND_PTVST   -0.00115922     0.00287665      -0.402976      0.68973
     ND_Indust   -0.00466292     0.00290854       -1.60318      0.11904
      ND_Water   0.000222536    0.000773145       0.287832      0.77539
        ND_Com    0.00542294     0.00496221        1.09285      0.28288
      dist_CBD      -1.76975       0.639495       -2.76742      0.00944
      tm_busCBD     0.861978       0.826477        1.04296      0.30503
      tm_trnCBD     0.256384        0.15748        1.62804      0.11364
-----------------------------------------------------------------------
```

The hospital locations and PTV bus stops are significant because when the hospitals were built, the authority might looking for a cheaper place to buy for the hospital. The bus stops were developed later on because, in the year 2006, the community were less crowded and sold value of less but the time passes by the people were started to live and annexe the boundary.

The 2011 census year was representing the increasing rate of house prices of different suburbs of study areas (Fig 2.8). From the Local moran Index, the cluster pattern changed to several suburbs in the Maribyrnong and one suburb in Brimbank LGA. High-high cluster is becoming extensive in this census year 2011.

Table 2. Changes in median house price from 2006 to 2016 of access to amenities

```
REGRESSION
----------
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set          :   GeodaZ070519
Dependent Variable :      Gr16Y11  Number of Observations:    43
Mean dependent var :      31.0845  Number of Variables   :    12
S.D. dependent var :      13.9642  Degrees of Freedom    :    31

R-squared          :     0.483144  F-statistic           :      2.63436
Adjusted R-squared :     0.299743  Prob(F-statistic)     :    0.0166909
Sum squared residual:     4333.79  Log likelihood        :     -160.194
Sigma-square       :        139.8  Akaike info criterion :      344.388
S.E. of regression :      11.8237  Schwarz criterion     :      365.522
Sigma-square ML    :      100.786
S.E of regression ML:     10.0392

---------------------------------------------------------------------
     Variable      Coefficient    Std.Error    t-Statistic   Probability
---------------------------------------------------------------------
     CONSTANT         49.5362       10.2137       4.84997       0.00003
       ND_edu    -3.4556e-005  0.000166998      -0.206924      0.83742
      ND_Park    -0.00298867    0.00275958      -1.08302       0.28715
      ND_Hosp     0.00103979   0.000798788       1.30171       0.20260
      ND_PTVB    0.000536747    0.00334458       0.160483      0.87354
     ND_PTVST     -0.0022681    0.00176396      -1.28581       0.20803
    ND_Indust    -0.00296079    0.00178351      -1.66009       0.10698
     ND_Water     -0.000114   0.000474091      -0.240461      0.81156
       ND_Com      0.0048794    0.00304282       1.60358       0.11895
     dist_CBD     -0.588292      0.392137       -1.50022       0.14367
     tm_busCBD     0.0510853     0.506794        0.100801      0.92036
     tm_trnCBD     -0.065484     0.0965662      -0.678125      0.50272
---------------------------------------------------------------------
```

It was the sign that the median house price is going to go out to the more suburbs and not stay in the same suburbs. It was found that the people were looking to buy the house any suburbs close enough to the CBD. Even though global clustering of suburbs suggesting the importance of spatiality of dependent variables. Inhomogeneity in the neighbouring districts underlying accessible factors that trigger the high-high cluster.

Table 3: Changes in median house price from 2006 to 2016 of access to amenities

```
SUMMARY OF OUTPUT: ORDINARY LEAST SQUARES ESTIMATION
Data set          :   GeodaZ070519
Dependent Variable :      Gr16Y06  Number of Observations:    43
Mean dependent var :       102.31  Number of Variables   :    12
S.D. dependent var :      43.8351  Degrees of Freedom    :    31

R-squared          :     0.569706  F-statistic           :      3.73125
Adjusted R-squared :     0.417021  Prob(F-statistic)     :   0.00185986
Sum squared residual:     35553.1  Log likelihood        :     -205.442
Sigma-square       :      1146.87  Akaike info criterion :      434.885
S.E. of regression :      33.8655  Schwarz criterion     :      456.019
Sigma-square ML    :      826.817
S.E of regression ML:     28.7544

---------------------------------------------------------------------
     Variable      Coefficient    Std.Error    t-Statistic   Probability
---------------------------------------------------------------------
     CONSTANT        117.262        29.2542       4.00838       0.00036
       ND_edu    -0.000225614   0.000478318      -0.471681     0.64046
      ND_Park    -0.00967495    0.00790401      -1.22406       0.23015
      ND_Hosp      0.0060462     0.0022879       2.64269       0.01278
      ND_PTVB      0.0158396    0.00957957       1.65348       0.10833
     ND_PTVST    -0.00519091    0.00505234      -1.02743       0.31217
    ND_Indust    -0.00915054    0.00510835      -1.79129       0.08302
     ND_Water   2.98739e-005    0.0013579        0.0220001     0.98259
       ND_Com     0.0144074    0.00871527       1.65313       0.10840
     dist_CBD       -3.199        1.12316       -2.8482        0.00774
    tm_busCBD      1.09075        1.45156        0.751429      0.45806
    tm_trnCBD      0.171006      0.276586        0.618276      0.54091
---------------------------------------------------------------------
```

The socio-economic status and the location of amenities identified significant of P-value for housing provided in tables 1, 2 and 3. The significance of correlations results that the hospital locations and public transport bus stops are essential. From the cluster maps and relationship, results suggest that spatial cluster patterns in common variation related to median house prices and access to amenities are indeed worth further investigation and therefore recommended as a future research direction.

6. CONCLUSION

This paper has proved, with a case study of the west of Melbourne, that the old-fashioned method of measuring housing prices and access to affordability measures is inadequate as it is overwhelming time distance to CBD become an accessibility cost. As it has been highlighted by Vidyattama, Tanton, and Nepal (2013) and Saberi et al. (2017a), a groundbreaking data-driven approach for evaluating household spending and access to services on weekdays and weekends, including public transportation, ownership of a personal vehicle and other non-work related journeys. The study shows that living in border areas as far away from Melbourne's CBD does not reduce the cost of living automatically. Once the locational access to amenities are considered in, the west of Melbourne, where most of the lower-earning households are living become less affordable while nearer distance suburbs to the CBD become more affordable.

The housing affordability locations should recognise an alternative lifestyle, neighbourhood characteristics, population attributes, and access to amenities, etc. The research also investigated the spatial clustering of median house prices and exposure to indicators of access to amenities. Least accessible suburbs are mostly detected to cluster together with low-low clusters or cold access to a measure and situated in the peripheral or the outer edges of the CBD. Whereas, high affordability suburbs are spatially clustered with higher median house prices and situated nearest distance to the CBD. Overall, this study provides accessible measures of locational importance of housing prices and its access to the affordability amenities, taking into consideration housing with temporal and spatial context as a case study of the west of Melbourne, Australia. This investigation is suggesting that the government policies and plans on the median house prices for low-income households and access to affordability measures should be in close synchronisation with better access to amenities as an investment plan.

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A Review of Local Economic Development and Negative Externalities Generated by A Coal-Fired Power Station in Regional Queensland: Recommendations for Future Actions

Ummey Fatima Safina[1], Gregory Jones[2]

[1] Central Queensland University

[2] University of Southern Queensland

Email: fatimasafina@yahoo.com

ABSTRACT

Eight coal-fired power stations are currently producing electricity in Queensland. All of them are in rural and regional Queensland. Gladstone power station (GPS) is the largest in Queensland with six operating turbines. Australia signed the Paris Agreement in 2016 but there is still debate around how to control or making technological innovations in coal-fired power stations in order to reduce greenhouse gas (GHG) emission. This study will examine the local economic development and negative externalities generated through coal fired power stations in regional Queensland, Australia, through a case study of Gladstone Power Station (GPS). This study adopted a systematic literature review method based on available literature and information on local economic development and externalities generated by GPS. This study found that GPS makes a significant contribution to the Gladstone community as most employees of GPS stay and spend money locally as well as GPS source most maintenance services and equipment from local suppliers. Additionally, GPS operates as a long-run-profit-maximising monopolist instead of looking at short-run-profit maximisation, hence they are motivated to try and minimise environmental impacts. However, GPS is the largest contributor to emissions of CO_2, nitrogen oxides and sulphur dioxide in Gladstone. GHGs are more prevalent in the Gladstone area compared to other areas of regional Queensland. Therefore, this study recommends a step wise transformation of coal-fired power station toward clean coal technology and/or socially acceptable market mechanisms to reduce the externalities.

Key words: Local economic impact, externalities, coal-fired power station, market mechanism, technological intervention, Australia

1. INTRODUCTION

Any industry has positive or negative impacts on the environment and society. These impacts result in benefits or costs respectively. Positives impacts brings monetary wealth and improved services to society. Negative impacts create negative externalities to both society and the environment. For example, Gladstone Power Station (GPS) has been contributing to the air pollution in Gladstone (DERM, 2011) and this is a one kind of negative externality that directly and indirectly effects the local community and environment. This paper examines the regional economic development generated from Gladstone power station as well as identifies the negative externalities generated in the Gladstone community and to the environment. Section

2 describes the data and methods used, followed by a literature review on economic development and negative externalities in Section 3. Section 4 describes the case study of Gladstone Power Station along with its economic impacts and negative externalities. Industry and government responses to addressing the negative externalities are described in Section 5. The paper conclusion is presented in Section 6.

2. METHODOLOGY AND DATA

This study followed an exploratory research approach and adopted a literature review method. Snyder (2019) grouped different types of literature reviews into three categories: systematic, semi-systematic and integrative. This study reviews the evidence and information already had been generated by previous studies, showing both the positive and negative contributions of coal-fired power stations at local level, in order to suggest future policy and practice changes. Addressing such issues, Snyder (2109) suggested following a systematic literature review. Systematic literature reviews target answering a research question or hypothesis. This study considered one research question but with two parts: What are the economic benefits and negative externalities? and What market mechanisms and technological innovations can help reduce negative externalities? This study included both scholarly articles, industry and government reports. In addition, the study also used some grey literature from regional and national newspapers and magazines.

Gladstone Power Station was used as a case study for this research because it is one of the largest coal-fired power generating stations in Queensland.
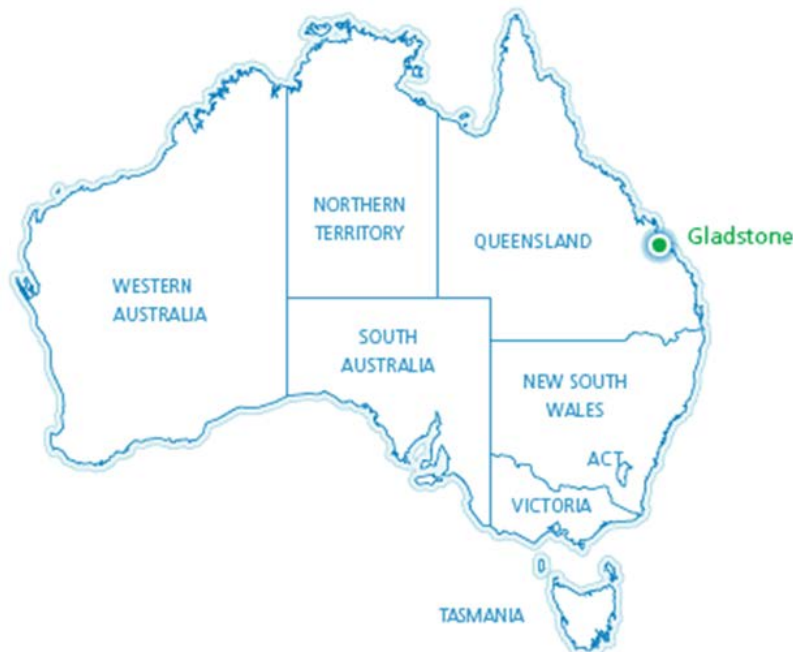

Figure 1: Location of Gladstone in Queensland, Australia, where the power station is located (Source: NRGGPS, 2018)

Gladstone is located about 500 kilometres away from the Queensland capital city of Brisbane (Figure 1). It's nearest regional city, Rockhampton is approximately 100 km away. Therefore, most of the economic benefits and negative externalities generated by this power station remain within the local Gladstone region.

3. LITERATURE REVIEW

3.1 Regional Economic Impacts

Any industry development in rural and regional Australia contributes to employment generation at local level. Additionally, most industries purchase their day to day services and some general equipment from the local businesses and contractors. These two (i.e., employment and local buys) directly affect local and regional economic development. However, coal fired power stations produced more than four-fifths of Australia's electricity (Burke et al., 2019), which is an input for all other industries and for most domestic power consumption. Such a huge volume of power production with minimum cost and use of domestic raw materials has serious economic significance as well as providing power security for the nation. Jenniches (2018) proposed a framework to assessing the regional economic impacts of renewable energy, which included location factors such as availability of source components such as wind, solar and geothermal energy and the supply chains. This can similarly be applicable to identifying the economic impacts of coal-fired powers stations. Therefore, economic impacts of the coal fired powers stations are not only limited to direct employment generation but also to the entire supply chains within and outside the region.

Secondly, these direct employment and purchase of resources create new jobs within other sectors such as child care and education, health and retail sectors (Burke et al, 2019). These are known as flow-on impacts of the direct impacts. This paper reviews both direct and indirect economic impacts of coal fired powers stations resulting from the economic activity of GPS.

3.2 Negative Externality and Full Price of Electricity

Negative externalities occurred when action of a one economic industry or sector directly affects another economic sector or the people functioning outside the direct market mechanisms (Kudelko and Wajer, 2014). For example, a coal-fired power station pollutes air and water by producing ashes, CO_2, hot water and heat transfer; and these are the externalities that have consequences to individuals and society in areas such as public health, environmental impacts and climate change. As an illustration, Figure 2 used D as the electricity demand curve and under as usual supply cost – S_1 is the supply curve with a price of P_1 at equilibrium point of E_1.
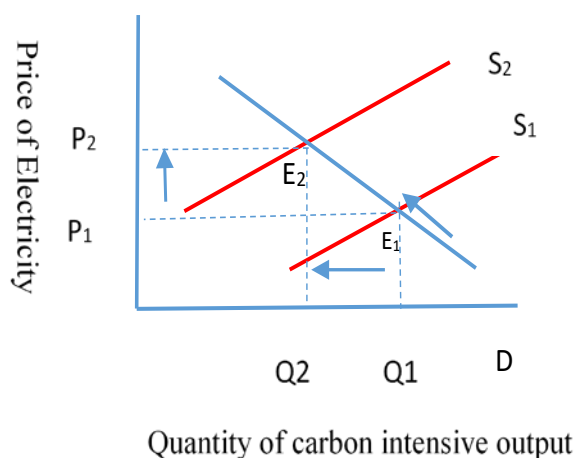

Figure 2: Price differences in electricity by showing carbon emission as an externality (Source: Slightly modified from Lyton et al 2016, pp. 243).

Under this market price, carbon emissions as an externality, has been ignored, and this is a win-

win situation for both the electricity consumers and the electricity company in the short run. But in the long run, such production and consumption behaviour under this pricing mechanism will affect local environment and human health. However, if the cost to reduce or mitigate those externalities (i.e., environment and health impacts) to be added to the usual cost of supply, then the full cost of electricity production will be increased i.e., P_2 shown in Figure 2. Therefore, full cost of coal-fired electricity generation is much higher than the usual cost model used.

Thereby, if the full cost model is applied to the coal-fired power production, then many consumers may face difficulty to afford the full cost price. Therefore, governments need to adopt policies and measures that can regulate the current production process and provided new sources of energy production (Lyton et al., 2016).

In summary, air (i.e., carbon generation) and water (i.e., hot water draining towards land and water bodies), are the two types of pollutions emanating from coal-fired electricity generation. These pollutions affect the local environmental and human health. Measuring those problems and finding an economically viable solution is very complicated because the impacts tend to be non-rival (i.e., applying to large numbers of people) (Gillingham and Sweeney, 2010). According to the theory of market operation, all parties should bear, both the full costs and full benefits, for their production and consumption respectively (Andrew, 2008) but this is currently absent within the coal-fired electricity sector in Australia. This paper further describes and analyses the facts and figures related to the coal-fired power station in Gladstone, Queensland in respect to the generated economic development and negative externalities.

4. GLADSTONE POWER STATION: ECONOMIC BENEFITS AND NEGATIVE EXTERNALITIES

Within Queensland, current generation of power is at 8,128 megawatts (MW) of electricity per day from eight coal-fired power stations and Gladstone Power Station (GPS) is one of them (DNRM, 2018). This is located in Gladstone within the central Queensland region (Figure 1. The Queensland Government built this power station in 1976 and is currently being operated by NRG Gladstone Operating Services (NRGGPS, 2018). GPS is the largest power station in Queensland in terms of its production capacity i.e., 1,680 MW per day (about 21% of the state coal-fired electricity). Many industries are reliant on this supply, these include Rio Tinto Yarwun Alumina, Queensland Alumina, Boyne Smelters Ltd, Comalco Alumina Refinery, Gladstone Port, LNG industries and Orica Chemical Plant are the main electricity consumers of power from this station. However, this power station also distributes electricity to the local and regional residences (GAPDL, 2005) via Ergon energy (a state-owned electricity distribution company). GPS has a permanent workforce of 290 (GAPDL, 2005), and they also require additional personnel during maintenance periods. The majority of them live and spend locally in Gladstone, demonstrating that GPS has both direct and flow-on economic impacts at the local level.

Overall, the electricity sector contributes about one-third of Australia's greenhouse gas (GHG) emissions and this trend is expected to continue (The Senate, 2017). In addition, more than 30 toxic substances including sulphur dioxide, nitrogen oxide and particulate matter are also produced from coal fired power stations (Lipski et al., 2017). However, CO2, SO2, NOs, PM2.5 are the most common emissions that contribute to causes of health hazards worldwide (Gaete-Morales et al 2018). These can cause a range of health impacts such as respiratory irritants, asthma, chronic lung disease etc (The Senate, 2017).

On the other hand, coal-fired electricity generation is one of the cheapest electricity production

methods in Australia. Therefore within the OECD countries, about 20.47 cents per KWh household electricity price in Australia compared to 37.84 cents per kWh in Germany, which is more expensive because Germany used more renewable energy than energy from coal (Tran, 2016). Therefore, the above-mentioned industries in and surrounding Gladstone, have access to cheaper electricity prices which help to make their products competitive in the world market but at the cost to local and regional communities, related to health impacts, water and air pollution. For example, Gladstone Power Station needs 245 million litres of cooling water an hour to its boiler, which is then discharged to a nearby river (Calliope river) (GAPDL, 2005).

About 30 percent participants in a study conducted by Queensland Health in 2009 expressed that they were highly concerned about the levels of air pollution in the Gladstone region (DERM 2011) and this was not due to only the pollution emanating from GPS but was also due to other contributing industries. DERM (2011) also found 187 contaminants include 22 metals, 145 organic substances and 20 inorganic substances in Gladstone's air. However, GPS is the largest contributor to emissions of CO2, nitrogen oxides and sulphur dioxide in Gladstone, and produces 43,000 tonnes of nitrogen oxides and 25,000 tonnes of sulphur dioxide each year (DERM, 2011; NRGGPS, 2008). It was also found that GHG gases are more prevalent in the Gladstone area compared to other areas of central Queensland (DES, 2018). In summary, GPS contributes to the air pollution in Gladstone, and this externality has both direct and indirect effects on the local community and environment, as well as contributing to the global climate change over a period of time. GPS does not count the full cost of their production as they pass the costs of pollution onto the community and the environment. Based on a European Union study, Biegler (2009) estimated GHG damage cost is about $39/MWh, which is a very significant amount. If GHG emission cost were accounted for in the wholesale price of Gladstone Power Stations' electricity, then many customers and consumers would have difficulty being able to afford to buy electricity.

As Gladstone Power Station is under the Queensland government jurisdiction and Queensland Competition Authority (QCA) determines the Queensland electricity market in general (QCA, 2018) as shown in Figure 3.
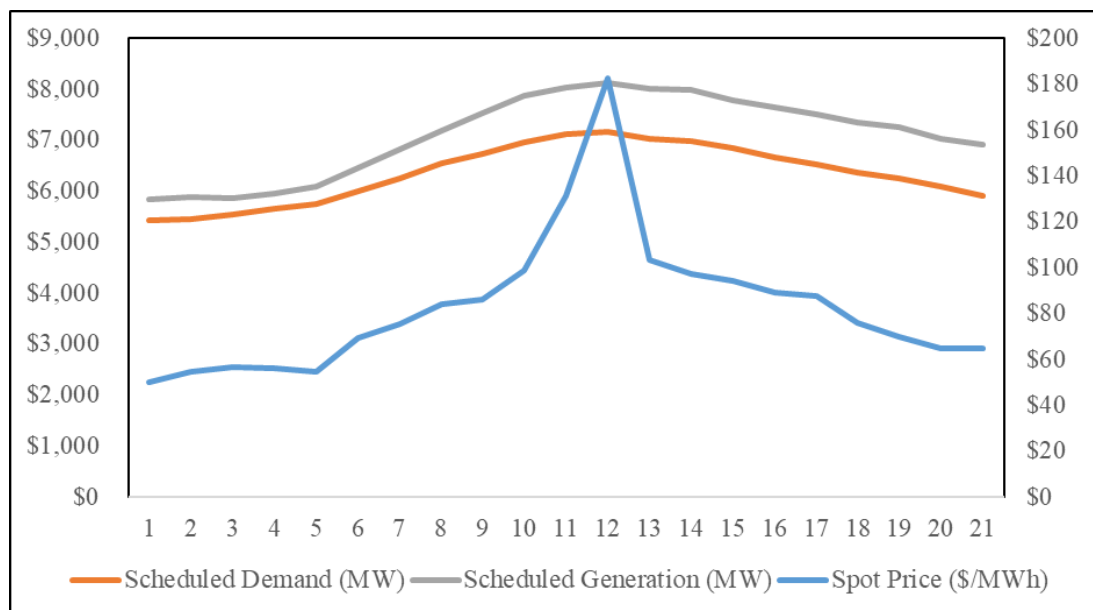

Figure 3: Spot prices of electricity market in Queensland within a day (12 September, 2018) between 1 am and 21 hour (9pm).

Electricity price is increasing over the period of time but this is consistent with the consumer

price index (Simashauser, 2008). Therefore, this price increase has not been able to control for the negative externalities born from carbon emission. As mentioned earlier, Queensland wholesale electricity market is a monopoly business, so the profit of those electricity generation companies is higher than it would have been under a competitive market. Because of monopoly nature of the business, GPS is able to determine its own price subject to negotiation with QCA. However, this is not a natural monopoly as some other producers are able to enter or access this market during the peak-summer period.

As GPS is a large electricity plant with an expected life span of over of 40 years, this is operated as a long-run-profit-maximising monopolist instead of focussing on short-run-profit maximisation. GPS is mostly a price maker instead of price taker.

Therefore, the Queensland Government has been trying to minimise these impacts by reducing the production capacity of the plant by increasing the state renewable energy production from solar and wind power, which is discussed in the following section. In addition, other state governments within Australia such as South Australia, Victoria and New South Wales are also trying to reduce the production of coal-fired electricity.

5. POLICIES AND TECHNICAL INNOVATIONS TO ADDRESS NEGATIVE EXTERNALITIES

Australia signed the Paris Agreement in 2016 but there is still debate around how to control or making technological innovations in coal-fired power stations in order to reduce greenhouse gas (GHG) emission. Over the last fifteen years in Australia, several policy changes have occurred in the area of carbon emission (i.e., minimising externalities) and electricity generation. However, there appears a mismatch between the federal and state governments (AEC, 2016). The federal government and some state governments such as Queensland, Victoria, South Australia and New South Wales (NSW) governments have been trying to reduce the levels of coal-fired electricity generation with the stated aim of reducing GHG gas emission.

At the federal level, emission trading scheme (ETS) has been discussing for many years but without unanimous consensus among the political parties. In 2007, the Rudd Labour government proposed a carbon Pollution Reduction Scheme (CPRS) (Lyton et al., 2016) but he lost his popularity and even lost his prime ministership. In 2011, the Gillard Labour government announced the introduction of a carbon tax, which came into effect in 1 July 2012. A carbon tax is a one kind of government levy (or tax) on per tonne of CO2 emissions that should be equal to the external cost of carbon emission by an industry on to the society (Lyton et al 2016, pp. 244). However, the Abbott LNP government repealed this tax and set up an emission reduction fund in 2014. Until now, the federal government has been hesitant to install a market mechanism such as ETS to control the externality of the carbon generating industries because of fear in losing popular votes as well as pressure from vested interested groups such as coal mining and mineral industries and local politicians. One of the economic reasons behind such disagreement among the political parties relates to the increased cost to consumers and higher risk for bulk energy users such as mining, manufacturing and agricultural sectors (AEC, 2016), where electricity is used as input variable; therefore, an increase in electricity price will increase the price of each unit of products. Such an increase will cost Australian products more expensive and uncompetitive compared to the products from other countries, where electricity price is much lower than Australia but assume same level of productivity. Another way to reduce the levels of carbon emission is bringing new technologies into electricity production by 2050 but it would cost the government and the industries about $250 billion (Biegler, 2009)

and this was proposed under the CPRS in 2007.

Queensland Competition Authority (QCA), a legal authority of Queensland Government, usually determines the monopoly price and price related bylaws (Frontier Economics, 2014; QCA, 2001). QCA determines the wholesale electricity cost of supplying a regulated customer using a market-based approach. Previous they used a combination of Long Range Marginal Costs (LRMC) and a market based approach i.e., was known as benchmark retails cost index (Frontier Economics, 2014). The QCA separates the impact of carbon on wholesale prices as part of its determination. Therefore, they generally ignore the negative externalities associated with coal-fired electricity generation. The growth in electricity demand is attributed to hotter weather which has led to an increased demand for cooling in buildings and equipment (DEE, 2017), therefore the government sometimes uses market mechanisms for the commercial or industry users, who usually buy electricity from the power plant on both wholesale and spot price. During a hot summer in January 2017, Boyne Smelter Ltd (BSL i.e., Australia's largest aluminium smelter) paid $12,641 per megawatt hour as wholesale price, which is well above $40 MWh average (ABC, 2017; Biegler, 2009). Though BSL is a business partner of GPS (BSL, 2014), this pricing mechanism was enacted to control the demand of electricity consumption during the peak summer period. As a result BSL suffered when compared to their usual product price and about to face market failure. Now BSL is planning to curtail 8 percent of their usual production because of electricity price hikes (Barnham, 2017; BSL 2016).

Queensland Government also have started to diversify electricity generation by using production methods with lower or no carbon sources such as gas, Wind Turbines and solar. Overall Australia has reduced 4 percent of the brown coal-fired electricity generation (DEE, 2017), while Gladstone Power Station has reduced 35 percent of its capacity because of the current impact of renewable energy (Gellie, 2016). Previously, Queensland has shut down two coal-fired power stations and now they have a plan to shut down another two by 2030 (The Senate, 2017). The federal government is also keen to proceed an orderly closure process to encourage price stability and investment certainty (The Senate, 2017). In addition, technological intervention can reduce the negative externalities. Some of the technologies are still under a piloting stage such as integrated gasification combined cycle (IGCC) and carbon capture and storage (CCS) systems (Chen and Xu, 2010). Therefore, the future trade-offs would be choices between using clean coal technology and the prices. If technology changes cause a serious price hike increase, then it is unlikely be successful. However, technology will become cheaper if it is used globally. Therefore, the technology development and its translation should not only be the responsibility at the enterprise or individual level but should be at global and government level.

6.   CONCLUSION AND RECOMMENDATIONS

Australian federal and state governments are aiming to closing coal fired power stations in future to combat with the challenges of environmental impacts, however this can create problems associated with energy security. This paper examined the economic development and negative externalities generated through coal fired power stations in regional Queensland, Australia, through a case study of Gladstone Power Station (GPS). This study found that GPS makes a significant contribution to the Gladstone community as most employees of GPS stay and spend money locally as well as GPS source their most maintenance services and equipment from the local suppliers. GPS also functions as a long-run-profit-maximising monopolist instead of looking for short-run-profit maximisation. GPS does not distribute power to the household directly. On the other hand, GPS is the largest contributor to emissions of CO_2, nitrogen oxides and sulphur dioxide in Gladstone. GHG gases are more prevalent in the

Gladstone area compared to other areas of regional Queensland.

Therefore, this study suggests to install a market mechanism on GPS and other coal fired power stations in Queensland for their carbon emissions and then invest the carbon revenue for ecological services at local level. As coal-fired electricity generation is the cheapest system of power, this study recommends a step wise transformation of coal-fired power station using clean coal technology and/or socially acceptable market mechanisms to reduce the impact of externalities. As this study did not do any cost and benefit analysis for installation of clean coal technology but it is evident that coal fired power generation could be more affordable than any other methods of power generation. So, the future trade-offs would be choices between using clean coal technology and the prices. If the cost of technological changes results in serious price hikes, then it unlikely be successful. For example, a pilot project in Queensland, Callide Oxyfuel project was successful with carbon capture technology and electricity generation (CS Energy, 2016) but electricity production price was much more expensive than that of usual method. Therefore, the government, industry and the research organisation should work together to innovate cost-effective clean coal technology.

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Water and Sanitation Program in Decentralized Eastern Indonesia: The Roles of Community and Social Dynamics

Anggun Susilo[1], Yogi Vidyattama[2], Dewa Ayu Putu Eva Wishanti[3]

University of Brawijaya, Indonesia.

University of Canberra

Email: yogi.vidyattama@canberra.edu.au

ABSTRACT

The recent decentralization in Indonesia was expected to play a big role in development program that addresses local issue including water and sanitation. However, the lack of capability of local governments could be a barrier to deliver the adequate services. Therefore, this study looks at the policy implementation and how the community in the poorer regions of Eastern Indonesia deal with the water and sanitation issue. In particular, this study aims to assess the implementation of Community-Led Total Sanitation (CLTS) type programs. Based on survey, in-depth interview and using qualitative method, this study identifies the main actors and their contribution in the programs. The result shows that despite the required active involvement of Non-Government Organisation (NGO) and local community, the local government still hold a very important role in the delivery especially their frontline staffs that provide routine communication with the community. In addition, the result suggest that financial assistance is still needed by poorer communities to implement the program.

Keywords: water and sanitation; decentralization; developing countries; Indonesia

JEL code: R58, R11, O21

1. INTRODUCTION

Water and sanitation is a serious concern especially in the developing countries. The United Nations (UN) has stated clean water and sanitation as the sixth goal of the 17 Sustainable Development Goals (SDG) and has accentuated the issue by pointing at millions of people who die from diseases that are caused by lack of access to water and better sanitation (United Nations. 2017).

In current Indonesia, decentralization has affected local development programs such as water and sanitation. Normatively, decentralization offers better service as it closes the gap between government and local community. However, better public provision often depends on the leadership and capability of local governments (Bahl et al., 2002; Beramendi, 2007). Therefore, there is a necessity to search for a policy model that can ensure sustainability in the water and sanitation sector.

One policy model that has been introduced with the support of international donors including the World Bank is Community-Led Total Sanitation (CLTS) (Water and Sanitation Program. 2017). This policy model suggests that to sustain the water and sanitation programs,

infrastructure development per se is not enough. Instead, it requires behaviour change and it involves sanitation marketing, creating an environment that enables the policy to work, performance monitoring and knowledge on policy and implementation (Water and Sanitation Program. 2017). The policy program is appealing as it is seen as effective by international donors and can be implemented in less developed countries.

Although becoming popular, CLTS has been criticized for shaming the community to intrigue a behavioural change and lack of financial support. Therefore, this study aims to assess the implementation of this program in the poorer area in decentralized Indonesia. In doing so, this study needs to identify the main actors (such as local government, civil society and village communities) and look at the possible synergies pattern that could introduce this behaviour change.

Decentralization and local community participation

Decentralization has become a new trend in the developing countries since the turn of the 21st century (World Bank 2005). The main expectation for decentralization is to better adapt government policy to local needs, and preferences and hence, improved efficiency in service delivery, especially in health and education (Morgan, 2002). Another expectation is that decentralization will bring higher levels of transparency and avoid the waste that arises when central governments initiate programs that are unsuited to local needs (Bardhan 2002).

Those expectations may not always become reality. Sub-national governments may not have the capability to deliver the required services (Bahl et al 2002). While decentralization has increased the share of spending on services and improved development at the local level (Arze et al, 2005), poorer regions struggle to provide even the most basic services (Rodriguez-Pose and Ezcurra, 2010). Poorer regions are also more likely to have institutionalized problems with corrupt and transparent governance, introducing the risk that local elites will take advantage of the opportunity to enrich themselves (Martinez-Vazquez and McNab, 2003). For these areas, the reallocation of functions from central to local governments may reduce both the size and quality of the services (Beramendi, 2007). In addition, a poorly designed system of decentralization may obscure lines of authority and responsibility and generate local confusion and instability (Rodden, 2006).

Further desirable outcome of decentralization is the establishment of community localism, which means the devolvement of policy making further to local communities (Evans, Mars, and Stoker 2013). This requires local actors to become more active in their policy contribution. Community activities become crucial in the poorer regions where the capacity and capability of local government cannot carry out all the new responsibilities. Therefore, the involvement of community leaders, voluntary groups, neighbourhood residents and civic associations in the policy decision making and policy delivery is increasingly important (Gaventa, 2004). This does not mean that the lack of capacity in local policy-making institutions would not have any effect, as Dare (2013) argues the lack of understanding about the importance of community in localism by both policy makers and community members has resulted in any attempts to implement localism becoming empty promises.

The Non-governmental organizations (NGOs) and civil society organizations (CSOs) may also have important roles in providing local leadership especially in developing countries (Hearn, 2007; Banks and Hulme 2012). In doing so, the CSOs and NGOs need to decide their position, learn their role as social entrepreneur and discover the best advocacy strategy (Dolsak, 2013). This includes considering the influence of the various authorities in a particular location (Rosenberg, Hartwig and Merson, 2008; Rose, 2011). This also includes getting the trust of the local communities. To do so, they have to make sure that the idea they are working on is

accepted and appreciated by the local community or general public (Marschall 2002)

Community-Led Total Sanitation

Sanitation and clean water are two of the most crucial public services needed and the delivery is difficult for poorer regions. Therefore, there is a huge need for community involvement in those regions. Community-Led Total Sanitation (CLTS) is one methodology or model used to involve the community in a sanitation program as well as elimination of open defecation (OD). This model acknowledges the importance to understand and engage with local practices to affect their sanitation and excrement disposal (Engel and Susilo, 2014). The crucial part is to understand the community's preferred types of sanitation to ensure maintenance and continuation of its usage (Black and Fawcett 2008; Jewitt 2011). In addition, communities are encouraged to conduct their own appraisal and analysis of OD and take their own action to become OD free ODF (IDS. 2011).

CLTS was initially promoted by NGO but has been used by the World Bank-led Water and Sanitation Program (WSP) since 2001 and was introduced to Indonesia in 2004 (Buhl-Nielsen, Giltner et al. 2009). Supported by the World Bank and many international NGOs, CLTS became a referred approach to overcome open defecation and developing countries in Asia and Africa adopt this method. CLTS follows four steps – pre-triggering, triggering, post triggering and scaling up (Kar and Chambers 2008:11). Although these steps are equally important, the triggering step is more recognisable especially its unique method named a 'transect walk'. A transect walk is an activity where members of the community follow a path to see an area of defecation, aiming to educate the community about the process and the danger of diseases spreading from open defecation (Kar and Chambers 2008). Importantly, the essence of this activity is "stimulating a collective sense of disgust and shame among community members" (Kar and Chambers 2008: 21).

There are issues in implementing CLTS. The first issue is the triggering step which often focuses on shaming the member of community. Although shock factor is needed to encourage behavioural change, the focus could have an adverse impact on certain groups in that community (Harvey 2011: 100). Engel and Susilo (2014) further show that at implementation level, CLTS often treats local perceptions and cultural barriers as problems rather than stepping stones and hence, is considered to be similar to "coercive, race-based colonial public health practices".

Second, the approach often neglects the fact that some communities do not have a required sanitation facility because they cannot afford and have no means to obtain it. In this case, the involvement and funding of local government is required. This is a deviation from the standard CLTS model which encourages more involvement from local communities while the involvement of an outsider is merely to initiate change (Kar 2003: 27).

Water and sanitation in decentralized Indonesia

The 2001 Indonesian Decentralization program plays an important role in the current effort to improve sanitation and water due to the large transfers of resources and authority from central government to local government (Hofman and Kaiser 2002, p. 1; Turner, M 2001, p. 80). One emerging problem from this decentralization is that local government is not used to handling these authorities. This is because historically, policy development and its execution were highly centralized in the national capital, Jakarta, including the development of public infrastructure.

As mentioned above, the water and sanitation program has become one of the top development program priorities in Indonesia, aiming to provide people across the country with equal access

to clean water and improved sanitation in 2019. To achieve this ambition, the government released Ministry of Health regulation to governs the implementation of CLTS or in *Bahasa* known as *Sanitasi Total Berbasis Masyarakat* (*STBM*). This shows that the initiative for this program has come from central government while the role of local government is to provide technical training in the field especially on toilet construction.

By definition, *STBM* refers to "an approach to change behavior in sanitation and hygiene by community empowerment through triggering" (Indonesian Ministry of Health 2014: Article 1). As with CLTS, the triggering is aimed to push collective behavioral change in communities. Local government also participates in triggering but it is done in partnership with NGO and health cadres from the local health centre. There are five core components of *STBM*, which are 1) stop Open Defecation, 2) use soap for hand washing, 3) drinking water and food disposal management at household level, 4) waste management and 5) liquid household disposal management (Indonesian Ministry of Health 2014). As in CLTS, *STBM* is planned to be a non-subsidy program, which means the community is responsible for its own water and sanitation improvements, including providing funding for constructing toilets. Despite this, the central government has piloted and continued to allocate capital spending on roads, irrigation, water, and sanitation infrastructure as part of specific allocation grant since 2011 (Lewis, 2014).

2. METHODOLOGY AND CASE STUDIES

Methodology

This study assesses whether CLTS, as a main method in the water and sanitation program, could be successfully implemented in poor districts and analyses how the different actors play a role in introducing and maintaining water and sanitation programs. To do so, this study applies qualitative analysis to two case studies in poor districts located in East Nusa Tenggara using data from interviews, field observations and various documents on water and sanitation. The participants of the interview included community members, public officials from district planning and health agencies, as well as NGO workers. These include *STBM* facilitators from various entities.

The interviews in this study provide a full picture on the various actors involved in the program, capturing their knowledge, current thinking and future plans and assessing their relationship with each other (Yin 2014, Boswell and Corbett 2015). Therefore, the interviews consisted of several open-ended questions to allow the researcher and participants to pursue an idea in more detail as well as to provide important insight into their activities and relationships (Yin 2014, p. 113). These were conducted in two waves. The first aimed to map actors, problems and basic information about the water and sanitation program in the two districts and identify key focal points in the program. The second wave focused on households as community members to collect information and perceptions from communities over the water and sanitation project.

Study sites

The two districts selected as cases for this study are districts of *Timur Tengah Selatan* (*TTS*) and *Sikka*, both part of the East *Nusatenggara* province. Nevertheless, the districts are located on different islands with *Sikka* in the Flores archipelago and *TTS* on Timor island (Figure 1). The locations of these two districts means they are likely to have different cultures. Indeed, in *Sikka* itself, there are two major cultural groups: the coastal residents (*Sikka-Krowe*); and the mountainous people (*Tana'Ai*). While coastal residents havebeen interacting with outsiders for a long time and consist of many ethnicities, the mountainous people have much less interaction.

Similarly, the mount *Mutis* in *TTS* has become a residential area for *Meto* people while other areas in *TTS* have relatively more interaction especially through *Kupang*, the provincial capital, around 100 kilometres from the district.
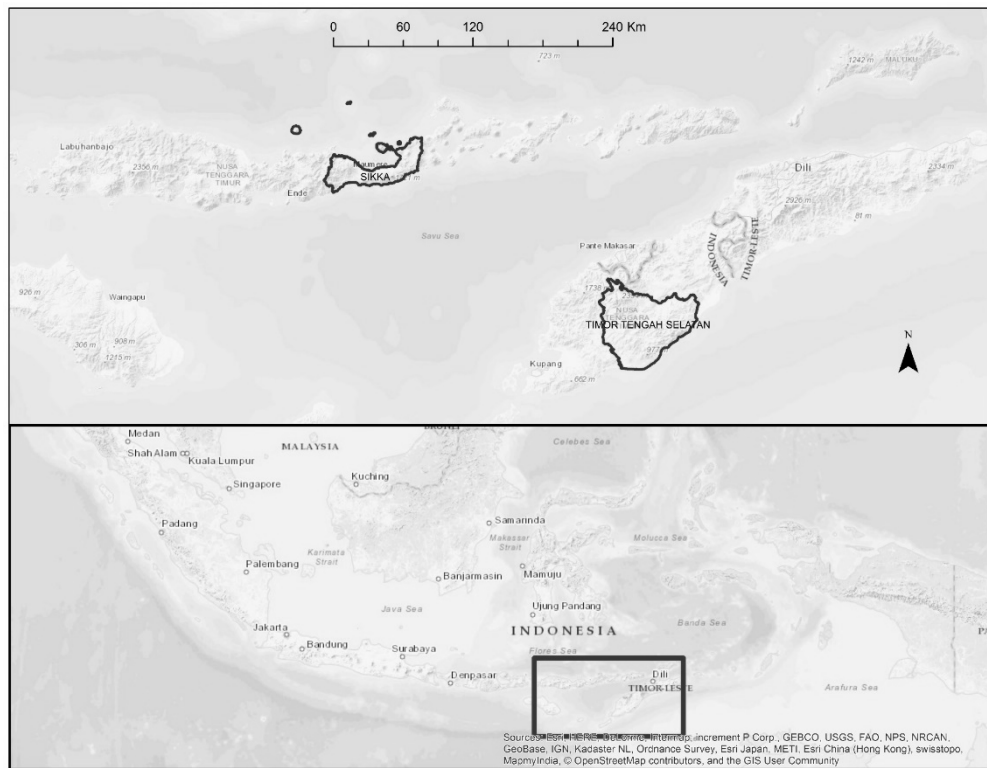

Figure 1. The location of *Sikka* and *TTS*

The East *Nusatenggara* province is one of the poorest provinces in Indonesia in terms of economic output (Hill and Vidyattama, 2016). The two districts per capita consumptions are also well below the national average (Table 1). Education levels are low although the literacy rate in *Sikka* is not too far removed from the Indonesian average. This is also the case for health conditions, indicated by life expectancy. Given these conditions, it is reasonable to expect that the two districts would need help from central government to work on the water and sanitation program especially in terms of the funding to improve facilities and infrastructure.

Table 1. Socio economic condition in *TTS* and *Sikka* based on Human Development Index component

NAME	Life Expectancy		Literacy rate		Mean Years Schooling		Adjusted Real Per Capita Consumption in Thousand Rupiah	
	2008	2011	2008	2011	2008	2011	2008	2011
TTS	66.6	67.1	84.2	84.4	6.1	6.7	600.3	609.6
SIKKA	68.4	69.3	90.5	91.7	6.1	6.4	592.9	600.1
INDONESIA	68.4	69.0	92.7	93.4	7.7	8.1	627.1	634.8

The two districts have a very different record with regard to sanitation. *TTS* surprisingly has more access to toilets as the data from Socio-Economic Survey (*Susenas*) indicates that less than 10 percent of households do not have access to a toilet at all. This is better than the national average, while conditions in *Sikka* are worse than the national average (Figure 2). Nevertheless, the trend in *Sikka* shows that access to toilets gradually improved until 2012 when it became equal to the national average. Unfortunately, data from 2013 and 2014 indicates that this positive trend is no longer maintained. The situation in *TTS* shows the proportion of households which do not have access to a toilet is relatively constant.
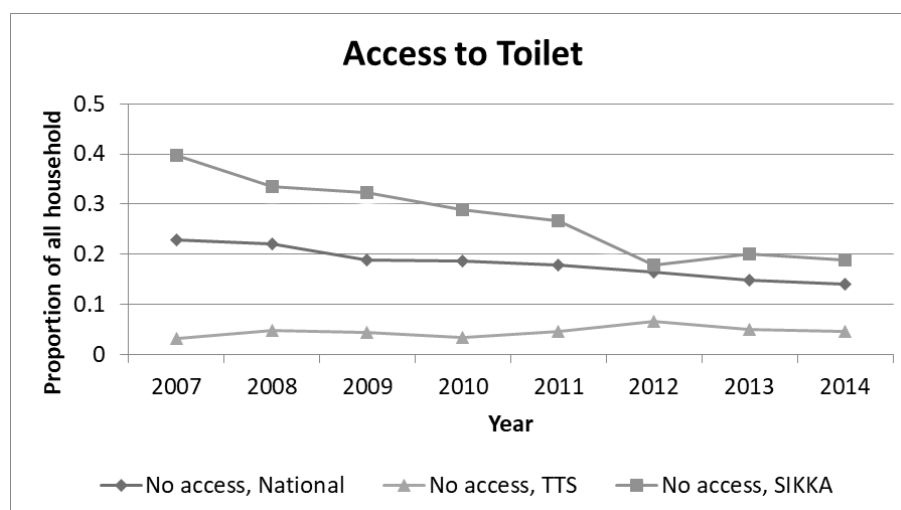

Figure 2. The access to toilet in *Sikka* and *TTS* based on *Susenas*

With less access to toilets, the proportion of open defecation in *Sikka* is expected to be higher. The data shows that the proportion of households using beach, field or garden as their location for defecation is very high (Figure 3). With the increase of toilet access, the figures showed a downward trend until 2012 but then it stalled. The number of households that used beach, field or garden for defecation in *TTS* is much lower than *Sikka*. Nevertheless since 2009 there has been a slight increase in the proportion. Therefore, both districts confirm that there may be issues preventing progress. This research will seek to explain this trend.
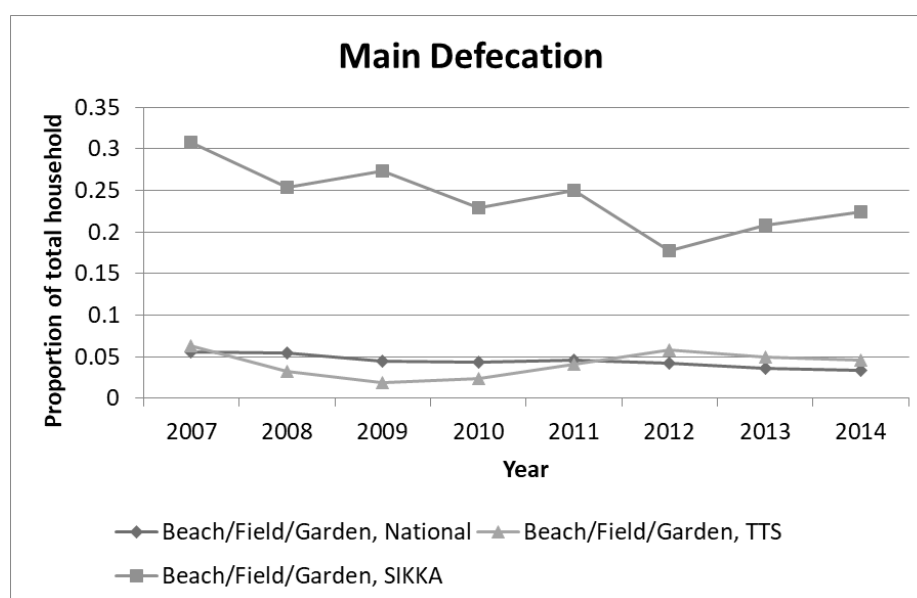

Figure 3. Open defecation in *Sikka* and *TTS* based on *Susenas*

3.   FINDING 1: TIMOR TENGAH SELATAN (TTS)

Access to toilet

The field observation and interview confirmed the *Susenas* data that access to toilets in the district is relatively good. Only two of the 11 households interviewed do not have a toilet at home. Members of these two households go to nearby forest to defecate. These two households claim that they know about the dangers of OD but they cannot afford to have a toilet at home. This is an indication that the community has awareness of health and sanitation issues. Another indicator of awareness is the increasing number of requested toilets from the community. This demand on toilets was specified in a successful approach by local government as part its housing projects, which require the house to have a toilet as a precondition.

There are several issues regarding sanitation in *TTS*. First, the existence of a toilet at home does not fully eliminate OD. For example, one household states that the location of their plantation is a 5 kilometre walk from home. Thus, it is very difficult for them to back home to defecate. Another issue is that although nine out of 11 households states that they have a toilet, they mostly only have the very simple type (*WC cemplung*). Only two out of nine households have a proper toilet (*WC leher angsa*) that retains a pool of water to ensure the waste and its smell remain enclosed (Figure 4).

Figure 4. The types of toilet observed in *TTS*

Water supply

One big challenge in *TTS* is its geographical character as it is semi-arid, meaning a water supply is hard to find. This is a critical problem not only for clean water provision but also for sanitation. In addition, most water springs belong to certain clan or family and not all of them allow other people access to this water. Thus, local governments have tried to persuade the clans to give the public access to their water. Several clans have agreed but asked for compensation, such as pigs, money and traditional ceremonies.

Another source of water for *TTS* people is from private companies who sell it from water tanks, distributed using trucks to people at a price of around IDR 2,000 per 10 litres. The exact price for each litre depends on the distance travelled and road conditions. Those trucks commute

daily from springs that are located in the city to the rural areas and one truck could carry approximately 5000 litres of water. According to one respondent who lived in *Biloto* village, people have to buy water from tanks because they cannot rely on the water springs, especially in dry seasons.

Actors

Local government

Our observation shows that local government plays a crucial role in the *TTS* water and sanitation program following an instruction from the head of district in 2012 which became the legal basis to enact the district water and sanitation program. In addition, *TTS* government also established a sanitation working group to increase coordination among the involved line agencies. Therefore, the local (district) government is not only providing the legal basis but also providing a platform for communication and coordination among those involved in the program.

Another important role of *TTS* local government is to communicate the importance of '*rumah sehat*' (healthy house) that contains a home toilet. This was part of the sanitation development acceleration program (P3SP) in settlements initiated by that local government. This program was implemented by a number of line agencies such as health agency, public work agency, development planning agency, and environmental agency as well as involving NGOs.

Despite their active role, the *TTS* government faces several issues in maintaining the water and sanitation program in the area. The most serious issues are internal rotation, sectoral ego and limited funds for financial support that can be provided by local government. With regard to financial support, another factor that lead to a low provision of funding is that sanitation and public health programs are not specifically listed as priorities for *TTS* government. They argue that this is because poverty, education and infrastructure such as roads are their top agenda items, rather than water and sanitation. One consequence of the lack of financial support is the lack of a sanitarian. Currently, one sanitarian can cover more than seven villages which are located in remote areas. The argument is interesting as the central government has allocated a grant scheme that can be applied for water and sanitation purpose but only for its infrastructure.

There are also problems related to communication with lower administrative levels (sub-districts and villages). A sub-district secretary confirmed that they need clear manual and technical guidance and standard operational procedures for programs like CLTS. Officials argue that this is necessary to avoid overlapping of tasks and authority which can cause officials at the lower administrative levels to hesitate to implement the program themselves.

NGO and community

In *TTS*, there are several NGOs, both local and international, that work on Water and Sanitation Programs, some of which overlap. One of these local NGOs is "Plan *TTS*". This NGO works mainly on program implementation and takes credit for decreasing the number of OD as it was recorded that 250 villages were free from OD at the end of 2015. Nevertheless, Plan *TTS* also acknowledges the role of local government, especially the P3SP program, in this success. Another NGO, community-based water and sanitation supplier (*PAMSIMAS*) provides training to make cheaper toilets. This training is held three times a year with a group consisting of 10 sanitarian marketers. Through this training, people can maximize local materials such as sand and also make agreements on cost-sharing toilets. According to *PAMSIMAS*, one cheap toilet made with this training costs IDR 100,000 (AUS$ 10)

While having considerable success with the sanitation program, Plan *TTS* faced a bigger hurdle in the water program mainly due to the conditions in *TTS*. "Plan *TTS*" has worked together

with local community-based organizations and the government agency to improve water supply systems. In addition, "Plan *TTS*" initiated development of a friendly water supply facility. However, this facility is not working properly and hence, the communities often have to drill up to 60 metres into the ground to extract groundwater, which gets harder in the dry season. To fulfil this need, the officers from the Local Department of Energy and Mineral Resources lent its drilling facilities at several determined water sources.

Generally, people in *TTS,* especially in rural areas, have difficulties obtaining clean water. Spring water is available but in very small amounts. The difficulty of finding water introduces another actor to fulfil this need, the private water company. As mentioned above, there are water companies that bring water using water tank trucks from outside the district. Nevertheless, there are local private drinking water companies that acquire water from local springs and small streams. The workers from those local companies then purify and distribute water in jerry cans, to be traded in the traditional markets or by selling directly around the neighbourhood. Besides the local private companies, children are also often instructed by their parents or elder members of the family to go to the spring or stream to collect freshwater in a jerry can after school. The children should be able to place the jerry cans in a cart rather than carry them long distances home.

Another option for the community to get water, beside buying it from private companies and getting it from water springs, is to get water from public buildings such as school or government offices. In our interview with a man in village *Biloto*, he said that he walked to a nearby school to get water which is confirmed by a statement from the school headmaster. Accordingly, the headmaster stated that people usually come to the school during the night and 'steal' the water from the tank. The school itself buys water from trucks using school operational assistance funds. According to the headmaster, the school needs about 10,000 litres per month at an estimated cost of IDR 600,000 (AU$60) to be used only for daily needs such as hand washing and for toilets. For drinking water, he stated that the school buys mineral water in 5 gallons (around 20 litres) container.

Elite capture

Local elites also play an important role in the water and sanitation program in *TTS*. Currently, there is a strong commitment among the local elites in communities at village level to help the program in *TTS* to work. Furthermore, these supportive elites are the ones who won the village elections. Therefore, there is a concern that the program could be difficult to sustain if the next election winners are not supportive to the program. One factor that reduces this concern is the fact that water programs and issues are usually a main topic in the political campaigns.

These local elites also have another role in water supply since the main source of water in *TTS* is the spring owned by a famous clan. In addition, there is also some public access to this water. Although the spring is located under private property, access is granted through a traditional ceremony to mark this agreement. In this ceremony, local authorities such as *Kecamatan* (sub-district) and *Desa* (villages) give a number of animals such as pigs to the land owner as a symbol of 'asking permit' to access the water. In addition, the private property status could be of benefit to the spring itself according to the truck driver who became our respondent. Because of limited access, the spring is easier to manage. Contrastingly, if the spring was public, everyone would be able to come and take the water as much as they wanted. Over time, this would damage the spring and the water supply.

CLTS program

The interview shows that people are actually unfamiliar with the term (*STBM* or CLTS) but they remember having a regular visit from the local health centre (*Puskesmas)*. All households

confirmed that an official from *Puskesmas* visited them regularly. These visits mainly conducted a check on overall health conditions of all family members. Nevertheless, the visit also became part of CLTS implementation. This is confirmed by a sanitarian respondent. She stated that the list of questions used as guidance when they conduct home visits also contains instructions to check water conditions and the toilet besides the regular issues such as immunization and any signs of disease symptoms.

A CLTS facilitator from the NGO further stated that although unfamiliar with CLTS (or *STBM*) most people remember the triggering and transect walk which involved the residents walking around the village to see the human faeces scattered due to open defecation and saw a simulation on how it may end up in food and water consumed by the residents. However, this was done at the very beginning of the program and not all residents were part of it. The program relies on pamphlets and public meetings. Nevertheless, people are more persuaded by visits from health officials, the provision of a toilet and the provision of clean water.

Provision of a toilet and clean water are important because poverty remains the most critical problem in *TTS*. The cost of a toilet at IDR 250,000 (AU\$ 25) is too expensive for the poor, especially those who live with big families. Moreover, many people interviewed were peasants who earned their living by going to the forest and picking any fruits or spices to sell at a nearby market. Therefore, many of the communities have difficulty in sustaining the project once the local government or NGOs are no longer involved.

Land ownership is another concern for the implementation of CLTS. Previously, we discussed private land ownership where water springs belong to certain families or clans. Although it has benefits as described above, not all clans allow people to get water from their land. Adding to this issue, much of the land in *TTS* is not legally certified, therefore clans or families can occupy it, leading to land conflicts which may affect the implementation of CLTS.

Despite many positive findings in *TTS*, some negative points were also received from the respondent in the district. One of the negative point is there is still a lack of coordination, especially between local government agencies from the district level and the local community. Ironically, this is happening due to the number of NGOs working directly in the village without the involvement of district government. This made some respondents feel that although they are NGO activities, the water and sanitation program came from central government (Jakarta) rather than the local community initiative or local government priority.

4. FINDING 2: SIKKA

Access to a toilet

One important finding from observations in *Sikka* is the disparity of sanitation conditions among villages. In *Wolomarang* village of the *Alok Barat* sub-district, access to a toilet is limited. Located near the beach, many households in this village do not have a toilet. One household that was interviewed mentioned that her family got a toilet from local government, however, it was already broken because of high tidal wave. Since then her family members defecate in open space (as shown in Figure 5). In contrast, all interviewed households in *Kecamatan Koting* have access to a toilet whether it is in the form of private or shared toilet (one toilet is for two or three households). Nevertheless, there is a limited supply of toilets especially from sanitation marketing groups. The group stopped producing toilets due to the limited supply of materials that need to be ordered first either from Makassar or Surabaya.

Figure 5. Example of open defecation at *Wolomarang* village

The other issue that affects access to a toilet is inefficient infrastructure, often due to a lack of coordination between local government and the local community. The lack of coordination is often the result of job division issues among local government's own agencies due to sectoral ego. Figure 6 shows a public toilet located in the local market, provided by government. To compare, there is a public toilet which is managed by the community located in the same market.

Figure 6. Public toilets in *Sikka* market, managed by local government and local community

Water supply

Compared to *TTS*, water is more available in *Sikka*. In the two sub districts visited, *Alok Barat* and *Koting*, only 130 out of more than five thousand households do not have access to clean water. All of these households are located in *Koting A* village of *Koting* sub district. The rest of the households in this village have adequate access provided by the district owned water utility company (PDAM). These 130 households will be prioritized to get water access by using

village funds in 2018.

There are still several issues with the water supply at *Sikka*. One of the examples is in *Hewuli* village, *Alok Barat* sub district. The village is known for its refugee camps. At least 300 households living in the village are refugees from *Palue* Island who came after the volcanic eruptions of Mount *Rokatenda* in 1996 and in 2013. When the first group of refugees came to *Hewuli* in 1996, the water supply was adequate. Water came from a nearby hill and was distributed by pipeline with full support from the local NGO. The problem arose when the second group of refugees arrived in 2013. With more households, the existing water supply was no longer enough. Due to the lack of governance, in terms of complaint mechanisms and regulation in the water distribution, the new refugees broke the pipe using hammers, tapped the water and channelled it to their houses. As a consequence, there is tension between the old and new refugees in *Hewuli*. Unfortunately, this problem has not been settled.

Actors

Local government

Similar to *TTS* government, *Sikka* also has specific regulations on water and sanitation. This is formally stated in *Sikka* local regulation number 1/2015 on "Drinking Water Management and Community-Based Improved Environment". The main difference between this regulation and the one in *TTS* is that the regulation in *Sikka* has been approved by local parliament and contains a certain law that regulates all people in the area while the instruction in *TTS* is a policy document that mostly concerns local civil servants in conducting their duties. Therefore, it is understandable why the instruction in *TTS* can be very specific about the implementation of CLTS whereas the regulation in *Sikka* is more general. According to information from senior staff at *Sikka* planning agency, although water and sanitation is one of prominent issues in this district, it is not yet fully prioritized. Poverty, education and lack of nutrition are considered to be more important.

Input from the planning agency also indicates that staff rotation is the biggest issue in maintaining the sustainability of the water and sanitation program. Dedicated people who had actively engaged with the program from the start were rotated and posted to other line agencies resulting in a lack of continuity for the program. This is confirmed by staff from the district health agency. Therefore, the water and sanitation program in *Sikka* has a lack of coordination especially with regard to local stakeholders.

NGO and local community

NGOs in *Sikka* are playing the role of facilitator for the water and sanitation program. However, this role is often affected by the lack of coordination among stakeholders. One CLTS facilitator said that only a few meetings (up to three) were held yearly. Therefore, there is lack of clarity over how to handle problems such as a broken pipe, including its reporting procedures. This is confirmed by another NGO who stated that instead on concentrating on CLTS, their work is largely on technical aspects such as piping and water distribution. This is despite the fact that the NGO has close coordination with line agencies like PDAM. The lack of coordination has led to dissatisfaction and comment from NGOs that the district regulation, initiated and legalized in 2015 by local government, was only a 'lip service', meaning it was an official statement, but its actual implementation fell far from expectations especially when no funds were allocated to support the regulation.

In this situation, the communities in *Sikka* need to be more proactive. One example of community initiative was a toilet contract. Although local government involvement was minimal, this contract was made possible by the rules and regulations it set up. As can be found in *Koting A* village, the local government rules and regulations had encouraged a strong

commitment by local residents and approval by the village head. The contract allowed households who did not have toilet to sign a 'social contract' with the village local government to help them construct toilets in exchange for fulfilling certain promises such as maintaining the toilet. When households failed to meet their obligations, penalties would be applied. For example, the village head could suspend any social assistance such as the rice subsidy and administrative services. This community agreement was quite successful in assisting *Koting A* village to become free from open defecation. Unfortunately, these toilet contracts were discontinued due to complaints to the village council about an imbalance of bargaining among community members which will be discussed in the next section.

CLTS program

The implementation of CLTS varies in different villages in *Sikka*. In *Koting* sub district which was declared as ODF in 2014, the information on CLTS was relatively well distributed. We visited ten households in *Koting A* village with a sanitarian from *Koting* health centre. The sanitarian assessed the condition of household members based on a checklist. The assessment ranged from access to a toilet, immunization status, water inspection and monitoring. During the visit, we also checked the water tanks. In *Koting A* village, we found that a number of families used a shared toilet and water tank. The village head said home visits by a sanitarian to monitor ODF status is quite regular. However, he admitted that there were still a number of families that did not get sufficient information about CLTS so he always tries to remind people about the program in every village meeting.

The *Hewuli* village uses a different approach to conduct CLTS. They use school education to introduce CLTS to the students. As stated by the school headmaster in this village, CLTS is integrated into the school curriculum. On a regular basis, there are school activities for hand washing and tooth brushing practice. Children are also educated on how to use toilet (toilet training). However, the information does not always get transferred to the home. This is indicated by information from one household that was interviewed during the visit. A mother said that she never heard about CLTS/*STBM* or regular home visits by a sanitarian.

Kecamatan Alok Barat is another different story. We were assisted by a sanitarian to check conditions in *Wolomarang* village. We had been informed that the village was considered 'unsuccessful' in terms of the water and sanitation program. The location of the village near the beach is one factor that made the water and sanitation program less than successful. In addition, the villagers are considered unhelpful. The sanitarian stated that most of them are not local people of East Nusa Tenggara which makes it difficult for the sanitarian to relate to them. The information about health and sanitation had been distributed many times to them but it still did not change their behaviour.

There are other local dynamics related to social and institutional contexts that make it difficult to implement CLTS. Conflict among stakeholders plays a big role in this. As mentioned earlier, the toilets contract in *Koting A* village was discontinued due to the existing disagreement between the village head and village council. The village council opposed this initiative viewing it to be risky and unfair. This was because the contract required the poorest people to construct a toilet or be penalised by the removal of social assistance such as a rice subsidy. Those people who were better off financially do not receive social assistance so could not be compelled to meet the conditions of the contract as there were no sanctions which could be applied to them. Another example is the *Hewuli* village mentioned earlier with tensions between the old and new refugees. The head of the neighbourhood blames local government for neglecting this issue by not enforcing the water governance settings which existed in the past to ensure all residents have equal access to clean water.

5. DISCUSSION

The role of local government in decentralized era

This study shows that local government has an important role in delivering public services such as water and sanitation. Although there is still little suggestion that the water and sanitation program is driven from central government, this does not appear to be significant and most respondents agree that local government plays the most crucial role in the implementation of this program. The findings also confirm that despite the adaptation of government policy to local needs and preferences, an active role of local government does not necessarily improve efficiency in service delivery as suggested by Morgan (2002). This study identifies that although setting up regulations is an important step, the problem is not about legal commitment but more about implementation. The picture from the two cases shows how poorer regions struggle to provide basic services (Rodriguez-Pose and Ezcurra, 2010). Although the CLTS method itself suggested that the role of local government was just to encourage the communities to conduct their own appraisal and take their own action (IDS, 2011), it still needs financial support that is allocated legally in the local government budget especially in poor communities.

Martinez-Vazquez and McNab (2003) suggested that poorer regions may have institutionalized problems that allow local elites to take advantage to enrich themselves and this is indicated in the two cases, especially in *TTS*, with regard to the ceremony and 'payment' required to gain access to the springs as a source of clean water. Nevertheless, the importance of the spring may outweigh the cost, and this has been an acceptable practice in local culture even before decentralization took place. In addition, information that we collected during the second field study confirms that the role of elites in water resources is needed in maintaining them properly to ensure adequate water supply. Such maintenance would not be guaranteed if access to water was free for everyone, as stated by one of our respondents.

There are additional things that prevent local governments from being more successful in delivering the services. The biggest obstacle according to the respondent is the internal bureaucratic system that enforces internal rotation among local government staff. Dedicated staff that have been trained in the water and sanitation program are regularly moved to other departments, subsequently interrupting the established communication and coordination methods that have been in place for years. Another problem with bureaucracy is that water and sanitation is not a priority program in both respective districts. Among the top ten priority programs, water and sanitation is only ranked fourth or fifth according to the district development planning agency. The agency stated that the top priority programs are usually infrastructure projects and poverty reduction although it can be argued that water and sanitation are both infrastructure projects which can be used to effect poverty reduction. This lack of prioritization does not only mean that water and sanitation programs have less financial support but also affects the decision in allocating the "dedicated staff" and their rotation. This problem can also open up the discussion on the provision of central government grant that can be applied for water and sanitation infrastructure especially on whether it needs to cover the staff salary as well. Having said that, the Indonesian specific allocation grant is usually allocated for infrastructure while general allocation grant is mainly used for salary and the most successful staffs in communicating the program are usually already gain the trust as they are the staff of the local health centre.

The community involvement and localism

Another expectation from decentralization is community localism that includes local communities in the policy making process (Evans, Marsh, and Stoker 2013). The two cases

show that it is crucial where the capacity and capability of the local government cannot carry out all the new responsibility transferred from central government in decentralization. The localism is more needed in *Sikka* where the district government has been less successful in delivering their message to the residents. The toilet contract agreement and *Sikka* market community toilet provide good illustrations of localism. In addition, the toilet contract agreement also shows the importance of lower level local government at *Kecamatan* (sub-district) and village level.

Some success stories in the two districts also show that the service delivery needs to involve community leaders, voluntary groups, neighbourhood residents and civic associations (Gaventa, 2004). In the two cases, the facilitators from both NGO and the health centre play a very important role in communicating as well as assessing the condition of water and sanitation in the household. The observations especially show the importance of regular home visits. Another example of important initiatives is the regular monthly meeting that is held by health centres. The importance of staff from these health centres showcase how lower level government (the sub district and village) becomes the front runner on water and sanitation programs. Above all that, the two cases, especially *TTS,* indicates that the program cannot be implemented without the acceptance of community leaders (including teachers and school headmasters) and neighbourhood residents. Given the involvement of all these elements, it is understandable why several respondents highlight communication and coordination among stakeholders as the key to the sustainability of the program.

The implementation of CLTS for water and sanitation program

In general, it appears that there are no significant problems on disseminating CLTS to local communities, especially those in rural areas. However, there are several lessons learned in the implementation of CLTS methods in these two districts. The first one is regular communication about the importance of toilets and the danger of open defecation have a more significant effect than triggering or using CLTS as jargon. This can be seen in *TTS* where good communication makes residents accept the dangers of OD without necessarily knowing about what CLTS is. It has appeared from the two cases that one crucial factor that made *TTS* more successful than *Sikka* is active and inclusive communication and coordination by the district local government. Second, social and cultural context is important in the dissemination process. This also confirms the point from Black and Fawcett (2008) and Jewitt (2011) that it is important to understand community preference to maintain the demand and continuation of a sanitation program. In the context of the two cases, the understanding of local culture and history as well as residents' socio-economic capability is crucial in the dissemination process. Those factors are also important to get support from the elite and access to the necessary resources for CLTS to be implemented. Third, given the CLTS is implemented in the poor areas, the two cases show that it is nearly impossible where the government, especially at local level, does not provide any financial assistance to construct the toilet either at home or communally, or in the case of *TTS* to provide a source of water.

Besides the three aspects above, the two cases also show some physical and topographical factors that may reduce the effectiveness of CLTS. Water supply is one of those factors. The most significant hindrance to water and sanitation is the availability of water springs (water supply). Without a continuous supply of water, it is impossible for CLTS to reach its objectives. The two cases are located in East Nusa Tenggara where it is commonly dry and semi-arid. Another factor is related to "practicality" involving a situation that needs quick action. OD that is still found in *TTS,* especially in mountainous areas, is due to limited access to a toilet in the field in which they work. The field is far from home which forces them to defecate there. This is similar to a situation that we found in *Sikka,* especially those who live near the beach, due to

limited access to private or public toilets.

6. CONCLUDING REMARKS

This study has analysed how the CLTS is being implemented to deliver the water and sanitation program to two poor districts in the Indonesia decentralization era. It shows how important the local (district) government role has become. Besides setting the policy framework, local government also needs to be more involved in the implementation especially in communicating and coordinating the delivery of the program. This is despite the active involvement of NGOs and the local community. This study shows that in the implementation, good, consistent and continuing communication can be more important than the triggering step in CLTS. This needs to be adapted to the socio-economic-geographical conditions and the local culture in the area. This includes the possibility of financial assistance, which is not suggested in the original CLTS method. The Indonesian central government has introduced the infrastructure grant that can be applied for water and sanitation purpose but the assistance may still be needed to retain the frontline staffs who become the main communicators of the program to community.

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