平成 30（2018）年 7 月 18 日

博士論文審査結果報告
Report on Ph.D. / Doctoral Dissertation Defense

政策研究大学院大学
教授　　土谷　隆

審査委員会を代表し、以下のとおり審査結果を報告します。

On behalf of the Degree Committee, I would like to report the result of the Ph. D. / Doctoral Dissertation Defense as follows.

<table>
<tr><td>学位申請者氏名
Ph.D. Candidate</td><td colspan="3">Molina Lopez Andres Antonio</td></tr>
<tr><td>学籍番号
ID Number</td><td colspan="3">DOC13101</td></tr>
<tr><td>プログラム名
Program</td><td colspan="3">公共政策プログラム
Public Policy Program</td></tr>
<tr><td rowspan="5">審査委員会
Doctoral Thesis Review Committee</td><td>主査
Main referee</td><td>土谷　隆
TSUCHIYA, Takashi</td><td>主指導教員
Main advisor</td></tr>
<tr><td>審査委員
Referee</td><td>大山　達雄
OYAMA, Tatsuo</td><td>副指導教員
Sub advisor</td></tr>
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Referee</td><td>諸星　穂積
MOROHOSHI, Hozumi</td><td>副指導教員
Sub advisor</td></tr>
<tr><td>審査委員
Referee</td><td>Khoo Boo Teik</td><td>博士課程委員会委員長代理
Acting Chairperson of the Doctoral Programs Committee</td></tr>
<tr><td>審査委員
Referee</td><td>吉井　邦恒
YOSHII, Kunihisa
（農林水産省農林水産政策研究所総括上席研究官 / Executive Research Fellow, Policy Research Institute, Ministry of Agriculture, Forestry, and Fishery）</td><td>外部審査員
Referee from outside institutions</td></tr>
<tr><td>論文タイトル
Dissertation Title

(タイトル和訳)※
Title in Japanese</td><td colspan="3">RAINFALL EFFECT ON SOYBEAN PRODUCTION IN PARAGUAY, STATISTICAL ANALYSIS, AND MODELING DEVELOPMENT TO MITIGATE RISK
パラグアイにおける降雨の大豆生産への影響の統計的解析とリスク緩和のためのモデル開発</td></tr>
<tr><td>学位名
Degree Title</td><td colspan="3">博士（公共政策分析）Ph.D. in Public Policy</td></tr>
<tr><td>論文提出日
Submission Date of the Draft Dissertation</td><td>平成 29（2017）年
6 月 26 日</td><td>論文審査会開催日
Date of Doctoral Thesis Review Committee</td><td>平成 29（2017）年
7 月 24 日</td></tr>
<tr><td>論文発表会開催日
Date of the Defense</td><td>平成 29（2017）年
7 月 24 日</td><td>論文最終版提出日
Submission Date of the Final Dissertation</td><td>平成 30（2018）年
7 月 4 日</td></tr>
<tr><td>審査結果
Result</td><td colspan="3">合格
Pass　　不合格
Failure</td></tr>
</table>

※タイトルが英文の場合、文部科学省に報告するため、和訳を付してください

If the title is in English, please translate in Japanese in order to report MEXT.

論文要旨 Thesis overview and summary of the presentation.

This thesis conducts a quantitative analysis on relation between soybean production and rainfall in Paraguay for a period of 23 years from 1991/2 to 2013/4. Based on the analysis, irrigation is proposed as a climate risk management mechanism in soybean production and its implementation is discussed from a viewpoint of public policy.

In the thesis, datasets of daily rainfall, temperature, and yield (yield per hectare) of soybean from 1991/2 to 2013/4 in four main production-prefectures of Paraguay was analyzed. It was shown that average rainfall and cumulative rainfall patterns are key factors explaining yield. The Accumulated Rainfall Concavity Pattern Index (ARCPI) was introduced as a new index in order to capture the effect of rainfall pattern on yield. ARCPI represents the interaction between rainfall distribution and yield. Linear regressions models to predict yield are developed employing average daily rainfall and ARCPI as explanation variables for each of the three rainfall categories: moderate, average and heavy rain.

In addition, it was shown that: (i) Yield monotonically (linearly) increases as average daily rainfall increases to the point of attaining the maximum and then declines also monotonically. (ii) The concave-shaped pattern shown in cumulative rainfall is generally counterproductive, regardless of the amount of rain. (iii) If accumulative rainfall at the 80 days after sowing falls in the range of 300 to 550 mm, the yield can be below 2,000 kg/ha with considerable probability so that a decision to irrigate or not has to be made at that point.

Based on the developed prediction models and the real yield data at Itapúa Prefecture in 2012, a counterfactual analysis is conducted to simulate the case where water is supplied by irrigation. A detailed comparison of cost and income indicates a considerable increase in net income suggesting merit of irrigation .as risk management infrastructure.

A field experiment for validating the findings and models developed in this study is conducted in cooperation with the Federation of Soybean Producers (FECOPROD), a local think tank (Instituto Desarrollo), through the funding of the National Council of Science and Technology (CONACYT). An outline of the experiment is also described.

Finally, implementation of a public policy mechanism that will minimize yield volatility by irrigation is proposed as a new risk management strategy in order to back up the existing risk management tools such as diversification, insurances, and debt-refinancing.

1. 審査報告 Notes from the Doctoral Thesis Review Committee (including changes required to the thesis by the referees)

The defence was held on July 24, 2017. The applicant presented his study based on the submitted draft and slides for an hour.

The review committee considered that a major new scientific achievement of this study is (i) introduction of the index ARCPI, (ii) development of prediction model of yield utilizing average daily rainfall and ARCPI, and (iii) their application to risk management and public policy.

A key findings is concavity of cumulative rainfall as a decisive factor for yield. The index ARCPI is introduced to capture quantitatively concavity of cumulative rainfall. Based on ARCPI, linear regression models for predicting yield is developed and applied to estimate increase of net income when irrigation is introduced to discuss how irrigation can be introduced into the country from public policy perspective. There is an on-going field experiment to validate the findings and the models developed in this study conducted by the largest production union of soybean production in Paraguay.

While the committee members considered that the scientific achievement as described above was adequate and sufficient for awarding degree, they had concerns that the submitted draft was yet immature and would need to go through a major and thorough revision before it is acceptable. In particular, the applicant was requested to (i) conduct a thorough literature review and rewrite whole introduction to locate his research from a more academic and subjective standpoint; current literature review and reference list are very poor. (ii) reorganize chapters and sections to improve readability and consistency. (iii) change the title of the thesis so that it reflects the content of the study more directly. (iv) correct numerous minor grammatical and stylish errors, typos and misconfigurations in the current version.

The revised draft was submitted under a new title on May 25, 2018 with a cover letter explaining the points of revision, and was sent immediately to the committee members for the second review. The committee members were fairly satisfied with the revision, but the following issues were raised for further consideration.

1. The applicant analyses yield and rainfall for four prefectures, Prefectures 1,3,5, and 6. But due to the lack of rainfall data in Prefecture 1, the rainfall data of Prefecture 5, which is in the neighbour of Prefecture 1, is used to analyse yield of Prefecture 1. This can cause bias in statistical analysis. The applicant should discuss this point.
2. The thesis argues that irrigation is a suitable option for farmers with 300 to 500 hectares of land, but why can’t it be suitable for farmers with less than 300 hectares?
3. The applicant may consider modifying structure of chapters and changing chapter names to improve readability.
4. There are still minor mistakes, stylish inconsistencies, typos scattering around. The applicant should put serious efforts to make his draft complete.

After all, the review committee concluded that the raised points for revision were not necessarily major and revision would be completed in a short time, and approved that the applicant submits a final version of the thesis after carefully revising the current draft based on the aforementioned comments and receiving a confirmation by the major reviewer that revision is done in a suitable and satisfactory manner.

The applicant does not have a journal publication about this research yet, but is expecting to publish a few papers out of it. A draft of the first paper is almost complete and is ready to go for submission.

2. 最終提出論文確認結果 Confirmation by the Main Referee that changes have been done to the satisfaction of the referees

The major reviewer confirms that the final revision is done in a suitable manner taking the comments from the review committee into account appropriately.

3. 最終審査結果 Final recommendation

The committee recommends that the degree of Ph.D. in public policy be awarded to Mr. Andres Molina.