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## ***Interactive comment on “Policy support, economic incentives and the adoption of irrigation technology in China” by R. Cremades et al.***

**R. Cremades et al.**

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### Authors' Response to the Comments of the Referees

“Policy Supports, Economic Incentives and the Adoption of Agricultural Water-saving Technology in China”

First, we would like to thank the referees for their careful reviews of our paper, it has been truly beneficial for the manuscript to incorporate your comments. In this letter we first reproduce each of the comments of the referees, and we explain our response on a comment-by-comment basis.

REFEREE COMMENT C779: 'A GENERAL REVIEW OF THE TEXT', BY DR. CHRISTOPHER MARTIUS.

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Dr. Christopher Martius' comment 1: First, what I find a bit misleading is the use of the term "irrigation technology". It could be interpreted as the introduction of irrigation technology where there was none before. But obviously this paper is dealing with areas where irrigation is already a fact, so logically there must be some kind and level of irrigation technology, even if simple. What they are therefore discussing is the introduction of "more advanced irrigation technology", and this comes in two groups, household- and community-based. The authors should consider making this distinction more clearly in their wording. In fact, in section 3, they clarify the issue by referring to Blake's classification, which has a third class, traditional technology. But the reader might find it more accessible to read this paper if this kind of clarification would already be made in the abstract, and not only in the third section of the paper, after 5 pages of text. Response: Thank you! We agree "irrigation technology" alone can be misleading. Therefore, we modify the manuscript using only these three terms to avoid confusions: "modern irrigation technology", "household-based irrigation technology" and "community-based irrigation technology". Modern irrigation technology refers to household-based or community-based irrigation technology. In the revised manuscript, the introduction section (1.1) clearly indicates the implications of these three terms.

Dr. Christopher Martius' comment 2: The conclusions seem sound. But what is completely missing is a joint discussion of the findings of the descriptive statistics (section 4) and the logit and Tobit models (section 6). It would be good if the authors could insert a section before the current conclusions section (7) where they look at the results of these three parallel approaches side by side and interpret and discuss them in light of each other. Currently this is not available, so the underlying assumptions seem to be that the results of the models are somewhat superior to those of the descriptive stats. But even the results from the two models are not compared to each other. Thus they have three different analytical approaches they are not exploring fully. The authors forego an opportunity to validate their different approaches against each other, which would improve and give more weight to the conclusions consolidated from both approaches. This analysis furthermore could add another layer of information, i.e.



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on the methodologies. It could well be that running just one of the models would be enough, or even that no sophisticated model is needed if the underlying stats are as clear as they are in this case. Response: Thanks for your comments, we have revised the conclusion section and including the discussion on the joint discussion of the findings of the descriptive statistics and the logit and Tobit models. The following is the revised conclusion section that have the joint discussion (Discussions and Conclusion section in the revised manuscript). “Overall, our descriptive and econometric analyses reveal that governmental support has played an important role in promoting the adoption of modern irrigation technology. Descriptive statistical analyses show positive differences in adoption levels of modern irrigation technology when subsidies available (Table 3). Moreover, econometric results demonstrate that the availability of subsidies has a positive and significant impact on adoption extent of both described types of modern irrigation technology (Table 5), and on adoption intensity of household-based technology (Table 6). These results are consistent with results from previous research (Bjornlund et al., 2009; Dinar and Yaron, 1992; Feder and Umali, 1993) and confirm the relevance of subsidies in encouraging adoption of agricultural innovations. In fact, subsidies appear as the most influential and comprehensive policy for encouraging the adoption of household-based and community-based irrigation technology. However, only 10% of villages are currently eligible for such support. Consideration should be given to extend the subsidy to include more farmers in the future. Since these subsidies are a public expenditure that also provides private benefits, they should be made available until the advantages of the technology are known to farmers and they adopt the technology by themselves.

Subsidies to motivate adoption should be combined with actions to promote knowledge of the benefits of advanced irrigation technologies amongst farmers. Statistical analyses show positive differences in adoption levels of household-based irrigation technology when extension service activities are accessible to farmers. This is corroborated by the econometric results, showing that the probability that farmers adopt household-based irrigation technology significantly increases when extension service



activities are accessible to farmers. This is in agreement with previous findings in the literature (Dong, 2008; Feder and Umali, 1993; Ommani et al., 2009). Conversely, the descriptive statistical analysis for the levels of adoption intensity of community-based irrigation technology do not show differences when extension service activities are accessible to farmers (Table 3). Similarly, the econometric results show that there is no impact of extension service activities on the adoption of community-based irrigation technology. This lack of impact might be because the decision to adopt community-based technology are highly influenced by local leaders – village, township and even county leaders. Nevertheless, the provision of extension services makes valuable contribution by spreading information about the beneficial aspects of the technology. Consideration should be given to expanding extension effort in those technologies and in areas of high potential benefit, but current low adoption because of limited awareness or knowledge. Overall, it seems clear that there is scope to strengthen the extent and integration of targeted subsidies and extension support for irrigation technology where there is most potential benefit.

Compared with governmental support, the present irrigation pricing policy has played a very important role in promoting the adoption of household-based irrigation technology. Descriptive statistical analyses show higher levels of adoption of modern irrigation technology when irrigation charges are levied and IFCI is greater than 0, but these differences are large only for adoption extent of household-based irrigation technology. Our econometric results confirm that the payment for water and the adoption level of household-based irrigation technology are positively and significantly related. Our result implies adoption of household-based irrigation technology is influenced by irrigation price policy. Irrigation pricing can play an important role in inducing farmers to change their irrigation behavior. This result is consistent with previous studies from Caswell et al. (1990), and Dinar and Yaron (1992). “

Dr. Christopher Martius' comment 3: I am also missing a broader discussion at the end of the conclusions, digging deeper in view of real life problems. This kind of mod-

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eling study remains rather theoretical and flat as long as no attempt is made to link the results to the underlying real-world activities and problems. E.g. the paper only considers subsidy and water pricing as yes/no questions but it does not venture into a discussion on whether these financial incentives/disincentives are well chosen with regard to the level of the farmer's financial means (or different levels of different farmer groups, wealthy and poor, large- or small-scale). Small changes introduced in the level of these subsidies could go far in creating further favorable or unfavorable conditions. I understand that this was not the subject of the study, but the authors should at least demonstrate that they are aware of this subject and point to the need for further studies in this regard before ill-fated policy recommendations can be given based on the results of this paper alone.. Response: Thanks for your comments. Econometric models reflect the real world since the data come from the real world and the relationship between variables revealed by the model reflect the real world relationship. Therefore, studies based on econometric models have been called as empirical analysis, not theoretical analysis. Of course, the construction of econometric model is based on theoretical assumptions. Since this is one common method used in many literature, we will not provide more detail information on this. However, we understand your meaning that we should further explore more issues based on the model results. Yes, this is one good suggestion but the focus of our paper is on whether policies and incentive mechanism have played role on promoting the adoption of household-based and community-based irrigation technology. Some other relevant issues can be further explored in the future analysis. In the revised manuscript, we have added the following sentence to indicate this interesting issue (included in the section: Discussions and Conclusions): "In addition, although policies and incentive mechanism can play role on promoting the adoption of modern irrigation technology, the significance for their role maybe differ by farmers' characteristics, such as their different degree of wealth. Such interesting issue also can be further explored in the future studies."

Dr. Christopher Martius' comment 4: Furthermore, basing the conclusions on the results of the modeling approach comparing only those two classes of household vs.



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community based technologies alone seems a bit dangerous, particularly because the different classes of technology represent baskets which each contains a varied group of highly different technologies, and looking at each of these in detail might provide additional insights. E.g. there may be underlying technical and financial differences between introducing sprinkler, drip irrigation, underground piping or lining of canals at the community level, which may make some of them more affordable or desirable than others for specific situations. Again, this is not the subject of the paper and does not diminish its merits, but it should at least be discussed.. Response: Thanks for your comments. We have added the limitation (as you pointed out) in the revised manuscript in the section “Discussions and Conclusions”: “Within the limits of available data, the econometric models used here have been applied to groups of irrigation technologies together rather than at the detail of individual irrigation technologies. The limitations could be overcome with further work through collecting more data for the individual technology, and combining both quantitative and qualitative methods. If possible, we can conduct follow-up surveys to create panel data with multiple time points that to further improve econometric estimates.”

Dr. Christopher Martius' comment 5: On page 1553, lines 22-26, a procedure is described that splits the cases into four groups when IFCI (irrigation fee) is larger than 0. But it remains unclear what has been done with these groups, how this was used to improve the analysis, and what the results are. Response: Thanks for showing there was a potential improvement here. We have eliminated the text and the rows in Table 4.

Dr. Christopher Martius' typos and text corrections: 1554 lines 2-7: you are repeating “in China” in each of the first 4 sentences. Consider removing it in 2-3 instances! – Accepted: 2nd and 4th instance removed. Page 1551 Line 4: “higher than that of”: remove “that” – Very good contribution, thanks! For the sake of synchrony of the structure of the sentences, we preferred to substitute “that” for “the levels”. P 1551/ L5: “technology both”: remove “both” – Accepted. Thanks for the careful revision! 1551/27: “when

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the subsidy policy is available for farmers" – the policy is not available to farmers, but the subsidy is. When you talk about the policy itself in the paper, this wording is correct, but where availability to farmers is concerned, you should correct the wording. The correct expression also is "available to". This passage therefore should be "when subsidies are available to farmers". – Accepted. Thanks a lot! 1554/21: "equals one" should be written as "equals 1" because this is about the number Accepted. Thank you! 1556/29: add space between "technology significantly" – This mistake could have appeared after the manuscript was sent, since the text was as suggested in the manuscript, we will keep an eye on it for the last version, thanks! 1557/20: "is negative and also significantly" – meaning not clear – Accepted. "Significantly" was changed by "significant". 1558/2: "supports and" replace by: "support measures and" – Accepted. 1558/19: "extended" replace by: "expanded" – Accepted. 1559/2: "with present" replace by: "with the present" – Accepted. 1559/4: "effect on encouraging" replace by: "effect into encouraging". Not accepted. We find "on" is the right preposition here. The authors would like to show their gratitude for your time and great contribution, thanks a lot for these points!

## REFEREE COMMENT C811:

'INTERACTIVE COMMENT ON "POLICY SUPPORT, ECONOMIC INCENTIVES AND THE ADOPTION OF IRRIGATION TECHNOLOGY IN CHINA", BY MARIYA ALEKSANDROVA.

Mariya Aleksandrova's comment 1: The quality of the paper could benefit from re-organization of the sections in the following standard format: 1. Introduction; 2. Materials and methods; 3. Analysis and results; 4. Discussion and conclusions. Response: We gladly acknowledge gratitude for your point and accept the comment, the paper has been reorganized.

Mariya Aleksandrova's comment 2: The Abstract is well-structured with one point to be highlighted – P. 1544/L. 6: make "incentives on the adoption of irrigation technology"

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more specific like “incentives on the adoption of household- and community-based irrigation technology”. Response: Accepted and modified accordingly to this comment and to a comment of the previous reviewer. We find the point has been introduced, thanks a lot.

Mariya Aleksandrova's comment 3: In Section 1 Introduction, on P. 1547/L. 8 add sub-section 1.1. Scope and objectives. Start this sub-section with the scope of the paper – after L. 8 add (move) part of the text included in sections 3 and 4 as follows: paste the text from P.1549/L.12-1550/L.11 and add information as regards the policies which fall within the scope of your study. Justify the choice of irrigation technologies and assessed policies. This information, once placed in the introductory part, would frame the analysis and the reader will have clearer idea for the specific focus of the study. Afterwards, specify the objectives and the structure. Response: Comment overall accepted, with some modifications in the same line. We agree that adding the piece explaining the types of modern irrigation technology helps the reader. We take your point and we move these sentences to the introduction, thank you! Since the scope of the paper is introduced before you suggested, and there is a paragraph about the policies already in the Introduction, we prefer to go beyond your suggestion and add 2 sub-sections, one for Scope and another for Goals and Objectives. The new sub-section Scope includes the text moved as you suggested, and a literature review providing information about the assessed policies and incentives. The objectives are introduced by some preliminary questions, so the new Objectives sub-section starts slightly before than suggested in the comment.

Mariya Aleksandrova's comment 4: Section 2 “Data” could be renamed as “Materials and methods” with sub-sections: 2.1. Sampling procedures (keep the text from P.1547/L.22 to P.1548/L.19); 2.2. Study sites (it would be good if more information on agriculture in the selected case study sites is provided, such as main cropping patterns and share of production dependent on irrigation); 2.3. Survey design and data collection (here place the text from P.1548/L.20 to P.1549/L.10); 2.3. Method for measuring

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the adoption of irrigation technology (here paste/move the text from section 3 P.1550/L.12-24); 2.4. Specification of econometric methods for modeling adoption of irrigation technology (i.e. paste/move here the whole C812 text from section 5; remove section 5 from the paper afterwards).. Response: Most of the comment is found truly useful and accepted, thanks!

Mariya Aleksandrova's comment 5: Remove the current sections 3 and 4, and Create new Section 3 entitled "Analysis and results" with sub-sections: 3.1. Adoption of advanced irrigation technology (here paste/move the text from P.1550/L.20 to P.1551/L.18); 3.2. Policy support, economic incentives and the adoption of irrigation technology in China (i.e. move here the relevant text from section 4; delete section 4 after); 3.3. Econometric results (here move part of the text from section 6 which outlines the results; the text which contains discussion on the findings to be moved in the next section 4; delete section 6 after).. Response: Accepted, we find this is a nice way to restructure the information and are grateful for this very valuable insight.

Mariya Aleksandrova's comment 6: Create new section 4 entitled "Discussion and conclusions" (place the discussion part from section 6 and the whole text of section 7). Enrich the discussion by referring to the findings not only form the econometric analysis, but also from the descriptive statistics. Add a paragraph highlighting (i.e. acknowledging) the limitations and uncertainties of the analysis and the obtained results (assumptions, models used, etc.). The findings suggest that subsidies, extension services and irrigation fees are important policy instruments to incentivize the adoption of advanced irrigation technologies, particularly at a household level. Therefore, the authors might add few lines on the prospects of and barriers to the use of these instruments within the current policy regime in China. Response: Thanks for your comment, we have added the new section "Discussions and Conclusions", your suggestions are all included in the new section: "4. Discussion and Conclusions"

In this paper, we have sought to explore the importance of governmental support measures and economic incentives on the adoption of modern irrigation technology



in China. Descriptive statistical analyses show that household-based irrigation technology has become noticeable in almost every Chinese village. In contrast, only about half of Chinese villages have adopted community-based irrigation technology. Adoption levels are lower at the household and plot scales. Amongst those households adopting modern irrigation technology, there are very few adopters that use it in all their crop-sown areas; this observation especially applies to community-based irrigation technology.

Overall, our descriptive and econometric analyses reveal that governmental support has played an important role in promoting the adoption of modern irrigation technology. Descriptive statistical analyses show positive differences in adoption levels of modern irrigation technology when subsidies available (Table 3). Moreover, econometric results demonstrate that the availability of subsidies has a positive and significant impact on adoption extent of both described types of modern irrigation technology (Table 5), and on adoption intensity of household-based technology (Table 6). These results are consistent with results from previous research (Bjornlund et al., 2009; Dinar and Yaron, 1992; Feder and Umali, 1993) and confirm the relevance of subsidies in encouraging adoption of agricultural innovations. In fact, subsidies appear as the most influential and comprehensive policy for encouraging the adoption of household-based and community-based irrigation technology. However, only 10% of villages are currently eligible for such support. Consideration should be given to extend the subsidy to include more farmers in the future. Since these subsidies are a public expenditure that also provides private benefits, they should be made available until the advantages of the technology are known to farmers and they adopt the technology by themselves.

Subsidies to motivate adoption should be combined with actions to promote knowledge of the benefits of advanced irrigation technologies amongst farmers. Statistical analyses show positive differences in adoption levels of household-based irrigation technology when extension service activities are accessible to farmers. This is corroborated by the econometric results, showing that the probability that farmers adopt

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household-based irrigation technology significantly increases when extension service activities are accessible to farmers. This is in agreement with previous findings in the literature (Dong, 2008; Feder and Umali, 1993; Ommani et al., 2009).

Conversely, the descriptive statistical analysis for the levels of adoption intensity of community-based irrigation technology do not show differences when extension service activities are accessible to farmers (Table 3). Similarly, the econometric results show that there is no impact of extension service activities on the adoption of community-based irrigation technology. This lack of impact might be because the decision to adopt community-based technology are highly influenced by local leaders – village, township and even county leaders. Nevertheless, the provision of extension services makes valuable contribution by spreading information about the beneficial aspects of the technology. Consideration should be given to expanding extension effort in those technologies and in areas of high potential benefit, but current low adoption because of limited awareness or knowledge. Overall, it seems clear that there is scope to strengthen the extent and integration of targeted subsidies and extension support for irrigation technology where there is most potential benefit.

Compared with governmental support, the present irrigation pricing policy has played a very important role in promoting the adoption of household-based irrigation technology. Descriptive statistical analyses show higher levels of adoption of modern irrigation technology when irrigation charges are levied and IFCI is greater than 0, but these differences are large only for adoption extent of household-based irrigation technology. Our econometric results confirm that the payment for water and the adoption level of household-based irrigation technology are positively and significantly related. Our result implies adoption of household-based irrigation technology is influenced by irrigation price policy. Irrigation pricing can play an important role in inducing farmers to change their irrigation behavior. This result is consistent with previous studies from Caswell et al. (1990), and Dinar and Yaron (1992).

Interestingly, the impact of irrigation pricing on the extent of adoption of community-



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based irrigation technology shows significant and negative values. An explanation for this is that there is some substitution effect between household and community-based irrigation technology. If farmers have higher incentives to adopt household-based irrigation technology, there may be fewer incentives to invest in community-based irrigation technology, which has an added barrier for adoption due to high costs. In fact, such relationship further indicates the significant role of irrigation pricing policy on promoting the adoption of modern irrigation technology. Compared with community-based irrigation technology, household-based irrigation technology is cheaper and easier to adopt by small and individual farmers, which is more consistent with the present production environment in China. Therefore, instead of investing in expensive community-based irrigation technology, the government should consider putting more effort into encouraging farmers to adopt household-based irrigation technology through appropriate and targeted irrigation pricing and extension policies.

Within the limits of available data, the econometric models used here have been applied to groups of irrigation technologies together rather than at the detail of individual irrigation technologies. The limitations could be overcome with further work through collecting more data for the individual technology, and combining both quantitative and qualitative methods. If possible, we can conduct follow-up surveys to create panel data with multiple time points that to further improve econometric estimates. In addition, although policies and incentive mechanism can play role on promoting the adoption of modern irrigation technology, the significance for their role maybe differ by farmers' characteristics, such as their different degree of wealth. Such interesting issue also can be further explored in the future studies."

Mariya Aleksandrova's technical corrections: Page 1544/line 4: remove "China"; P. 1544/L. 6: replace "in China" with "in the country"; Responses: Thank you! A slightly different combination of actions, focusing on the same point, addressed the issue in concurrence with the previous review. So the comment is accepted and solved together with a similar comment from the previous review. P. 1544/L. 5: replace "to understand"

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with “to explore”; Response: Accepted. Thanks! P. 1544/L. 7: add “the” in front of “results”; Response: Accepted. Thanks! P. 1544/L. 11: replace “householdbased irrigation technology at the village level” with “irrigation technology at a household level”; Response: the sentence is based in our results, and the suggested improvement could change the meaning substantially. Comment not accepted. Still we would like to thank you! P. 1544/L.13: replace “policy supports via” with “policy support instruments such as”; Response: We found this comment very useful, and preferred a similar change to address the potential issue: “support instruments like”. Thanks a lot! P. 1544/L.19-21: rewrite “possibly related to their substitution relationship, because having higher adoption of household-based irrigation technology reduce the incentives to invest in community-based irrigation technology” in the following way “possibly related to the substitution effect, i.e. the higher rate of adoption of household-based irrigation technology leads to lower incentives for investment in community-based irrigation technology”; Response: Thanks a lot for this excellent suggestion! I still prefer to avoid the i.e. formalism for this case, so we accept it as follows: “possibly related to the substitution effect, that is, the higher rate of adoption of household-based irrigation technology leads to lower incentives for investment in community-based irrigation technology” P. 1544/L. 24: replace “Water is scarce in China.” with “The water resources in the country are scarce and . . .”; Response: Accepted. Thanks! P. 1545/L. 21: replace “technology is low in China” with “technology in the country is low”; Response: Accepted. Thanks! P. 1545/L. 24: replace “Issued in March 2011, the rural and agricultural parts of the 12th 5 year Plan” with “The rural and agriculture sections of the China’s 12th Five-Year Plan, issued in March 2011, . . .”; Response: Accepted. Thanks! P. 1546/L. 26-27: modify “expenditures of four trillion RMB (over USD 600 billion)” as “expenditures of over 600 billion USD” (move “USD” after the values in all places in the text); Response: Accepted. Thanks! P. 1546/L. 4-3: to “policy support” add example (e.g. . . . .) and provide few references at the end of the sentence; Response: This is only an introductory sentence, in the following sentences there are 5 references that make the case quite broadly. Comment not accepted. P. 1546/L. 21: rewrite “that the “price” of water

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in terms of actual water charges is low in China's agricultural" as "that in China's agricultural sector, the "price" of water in terms of actual water charges is low"; Response: comment accepted, nice suggestion to make the main point more readable, thank you! P. 1547/L. 8-14: replace "overall goal" with "overall objective" and remove "With this goal in mind, the following objectives have been specified.". Start in the following way "More specifically, we first examine. . ."; remove "we will" in this paragraph and keep present tense (e.g. we examine); Response: Comment partly accepted. Future tenses have been removed. Goals are broad and objectives are narrower and might be measurable, we do not share your perspective in this point, still we would like to thank you for the interesting discussion. P.1550/L.16: "at the village level" should be "at a village level" Response: the study considers different levels in the descriptive analysis, so "the" refers specifically to one of them. Comment not accepted. P.1554/L.3: "To determine the effects of the explanatory variables" clarify by listing these variables in () or add new sentence. Response: In the revised manuscript, we have revised the sentence as the following (new sub-section 2.4): "To identify the influence of policies, economic incentives and other factors on the adoption of modern irrigation technology (household and community-based irrigation technology), the following several econometric methods have been specified:"

## EFEREE COMMENT C815:

## 'REVIEW', ANONYMOUS REFEREE

Anonymous reviewer's comment 1: This is an interesting and well elaborated manuscript. I like particularly the extensive size of the collected data set and the background information on irrigation practices and policy in China. However, I cannot help but find the conclusions quite generic and going little beyond the rather obvious. It is of course very useful to prove that policy measures have a positive impact, but I wonder whether, say, a policy maker reading the manuscript would really learn something useful to improve local irrigation policies. Rather than focusing on the part of the model that is explained by the support mechanisms, I would suggest that the paper focuses

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on that part that is not explained. I.e. why are subsidies and training not always effective? What type of farmers are left out? What determines whether these measures are effective? In fact, the model includes various other factors such as distance from field to plot and salinity, which seem to be significant (Table 5). I think that the authors can get much more out of the data than the manuscript reflects at this moment. Response: We agree with that the new section “Discussion and Conclusions” should be richer and made revision in the revised manuscript. The reason for having been so cautious about the conclusions in the submitted manuscript is that we only can discuss what we found based on our analysis. These questions (“why are subsidies and training not always effective? What type of farmers are left out? What determines whether these measures are effective?”) are very interesting, but not our research focus. In the future, if possible, we can further explore these issues. The following is our new section “Discussion and Conclusions”: “In this paper, we have sought to explore the importance of governmental support measures and economic incentives on the adoption of modern irrigation technology in China. Descriptive statistical analyses show that household-based irrigation technology has become noticeable in almost every Chinese village. In contrast, only about half of Chinese villages have adopted community-based irrigation technology. Adoption levels are lower at the household and plot scales. Amongst those households adopting modern irrigation technology, there are very few adopters that use it in all their crop-sown areas; this observation especially applies to community-based irrigation technology.

Overall, our descriptive and econometric analyses reveal that governmental support has played an important role in promoting the adoption of modern irrigation technology. Descriptive statistical analyses show positive differences in adoption levels of modern irrigation technology when subsidies available (Table 3). Moreover, econometric results demonstrate that the availability of subsidies has a positive and significant impact on adoption extent of both described types of modern irrigation technology (Table 5), and on adoption intensity of household-based technology (Table 6). These results are consistent with results from previous research (Bjornlund et al., 2009; Dinar



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and Yaron, 1992; Feder and Umali, 1993) and confirm the relevance of subsidies in encouraging adoption of agricultural innovations. In fact, subsidies appear as the most influential and comprehensive policy for encouraging the adoption of household-based and community-based irrigation technology. However, only 10% of villages are currently eligible for such support. Consideration should be given to extend the subsidy to include more farmers in the future. Since these subsidies are a public expenditure that also provides private benefits, they should be made available until the advantages of the technology are known to farmers and they adopt the technology by themselves.

Subsidies to motivate adoption should be combined with actions to promote knowledge of the benefits of advanced irrigation technologies amongst farmers. Statistical analyses show positive differences in adoption levels of household-based irrigation technology when extension service activities are accessible to farmers. This is corroborated by the econometric results, showing that the probability that farmers adopt household-based irrigation technology significantly increases when extension service activities are accessible to farmers. This is in agreement with previous findings in the literature (Dong, 2008; Feder and Umali, 1993; Ommani et al., 2009).

Conversely, the descriptive statistical analysis for the levels of adoption intensity of community-based irrigation technology do not show differences when extension service activities are accessible to farmers (Table 3). Similarly, the econometric results show that there is no impact of extension service activities on the adoption of community-based irrigation technology. This lack of impact might be because the decision to adopt community-based technology are highly influenced by local leaders – village, township and even county leaders. Nevertheless, the provision of extension services makes valuable contribution by spreading information about the beneficial aspects of the technology. Consideration should be given to expanding extension effort in those technologies and in areas of high potential benefit, but current low adoption because of limited awareness or knowledge. Overall, it seems clear that there is scope to strengthen the extent and integration of targeted subsidies and extension support

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for irrigation technology where there is most potential benefit.

Compared with governmental support, the present irrigation pricing policy has played a very important role in promoting the adoption of household-based irrigation technology. Descriptive statistical analyses show higher levels of adoption of modern irrigation technology when irrigation charges are levied and IFCI is greater than 0, but these differences are large only for adoption extent of household-based irrigation technology. Our econometric results confirm that the payment for water and the adoption level of household-based irrigation technology are positively and significantly related. Our result implies adoption of household-based irrigation technology is influenced by irrigation price policy. Irrigation pricing can play an important role in inducing farmers to change their irrigation behavior. This result is consistent with previous studies from Caswell et al. (1990), and Dinar and Yaron (1992).

Interestingly, the impact of irrigation pricing on the extent of adoption of community-based irrigation technology shows significant and negative values. An explanation for this is that there is some substitution effect between household and community-based irrigation technology. If farmers have higher incentives to adopt household-based irrigation technology, there may be fewer incentives to invest in community-based irrigation technology, which has an added barrier for adoption due to high costs. In fact, such relationship further indicates the significant role of irrigation pricing policy on promoting the adoption of modern irrigation technology. Compared with community-based irrigation technology, household-based irrigation technology is cheaper and easier to adopt by small and individual farmers, which is more consistent with the present production environment in China. Therefore, instead of investing in expensive community-based irrigation technology, the government should consider putting more effort into encouraging farmers to adopt household-based irrigation technology through appropriate and targeted irrigation pricing and extension policies.

Within the limits of available data, the econometric models used here have been applied to groups of irrigation technologies together rather than at the detail of individual

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irrigation technologies. The limitations could be overcome with further work through collecting more data for the individual technology, and combining both quantitative and qualitative methods. If possible, we can conduct follow-up surveys to create panel data with multiple time points that to further improve econometric estimates. In addition, although policies and incentive mechanism can play role on promoting the adoption of modern irrigation technology, the significance for their role maybe differ by farmers' characteristics, such as their different degree of wealth. Such interesting issue also can be further explored in the future studies."

Anonymous reviewer's comment 2: Part of this issue may be related to the structure of the manuscript, which I think is suboptimal. I consider the econometric methods as part of the methodology, and suggest that this is put much earlier in the manuscript. It can then be used as a starting point for subsequent presentation of results and discussion. This would allow to use the classic structure (as already highlighted by reviewer Aleksandrova) of introduction – materials and methods - results - discussion - conclusions. It would also logically lead to a more thorough discussion of the factors included in the statistical analysis. Response: We accept all the points about the structure of the manuscript.

Anonymous reviewer's comment 3: Lastly, as a minor point, the manuscript refers to "policy support" as the support provided by policy-makers to farmers. It would seem to be more common to me that policy support refers to mechanisms and tools to support policy making (e.g., policy support systems, simulations, etc). I think it is important to make this clearer to avoid confusion for the less attentive reader. Essentially, these support mechanisms are implemented by government, so it may be better to refer to the mechanisms as "government support", which has the added benefit that more details can be given as to what government (local, regional, national) provides this support Response: that is a very good and important appreciation, and we are extremely grateful for it. Still, we preferred to use the term "governmental support", while the term policies alone is used without the term support, which we find matches the topic and

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context. Comment overall accepted. Accordingly, we also modified the title: "Policies, Economic Incentives and the Adoption of Modern Irrigation Technology in China".

Anonymous reviewer's Specific comments: - 1548/23: "whether adopted any kind..." -> "whether any kind of irrigation technology was adopted in each plot" Response: very good point, thanks a lot for it. Comment accepted. -1550/1-3: I am not sure how these practices relate to the actual irrigation. Do you mean that some/all are used in combination with irrigation, as a way to make the irrigation more efficient? Response: there are three general techniques related to irrigation that avoid non-productive consumption of water: A) avoiding water leakage while transporting water to the field, B) distributing it homogeneously or only where necessary in the field, and C) keeping water in the plot with different means, including avoiding evaporation. These practices you mention relate to C) because avoid evaporation. Thanks a lot for making the point, we cannot include all this explanations in the limited text of an academic article. - 1556/29: "technology significantly" -> "technology significantly" Response: Thanks for your careful revision! As mentioned above, this mistake could have appeared after the manuscript was sent, since the text was as suggested in the manuscript, we will keep an eye on it for the last version.

## References

Long, J. S., & Freese, J. (2006). Regression models for categorical dependent variables using Stata (2nd ed.). College Station, Tex.: Stata Press.

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