Constraints to Farmers Willingness to Pay for Private Irrigation Delivery in Nandom, Ghana

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Abstract

The study investigated the constraints to farmers' intention to pay for private irrigation in Nandom District, Ghana. Using a key informant interviews and semi-structured questionnaires, the study collected data from 236 farmers. Data was analyzed with descriptive and inferential statistics. Kendall coefficient of concordance was used to determine the level of agreement among farmers in ranking of constraints. The study found financial constraint (low income) as the most important constraints to farmers' readiness to pay for private irrigation. Other important constraints were lack of ready market for output, crop pest and diseases, unstable output price, costly private services, inadequate supply of complementary inputs and lack of credit services. We concluded that lack of ready market, unstable price for farm produce and lack of credit services jointly worsen farmer's finances and consequently constraint their ability to pay even under condition of perfect knowledge of the benefits that could accrue from the technology. This study recommends the implementation of the proposed private irrigation service but management of the service should incorporate an efficient value chain in the management of the service.

1. Introduction

The Nandom district is largely rural with 80% of the economy dependent on rain-fed agriculture which is dominated by small-scale food crop (guinea corn, millet, maize, cowpea and groundnut) producers (NDA, 2014). Drought presents a serious threat to crop production in this area. The outcome is usually low crop output, low and unstable household income, worsened food insecurity and migration (Rademacher-Schulz and Mahama, 2012).

To address the problems of food insecurity and to increase the incomes of rural smallholder farmers, agricultural planners have focused on the development of irrigation facilities. Irrigated agriculture, is believed has the potential of providing water for all year farming and creating employment opportunities. This will help to stabilize food prices in rural and urban markets thus, ensuring food security and poverty reduction (Lipton, *et al*, 2003).

Under the existing financial circumstance of the Ghana, public financing of irrigation provision is unsustainable due to national budgetary constraints and as such cannot be solely relied upon to finance the provision of irrigation scheme (Namara, Horowitz, Nyamadi and Barry, 2011). Recent policy debates favour the participation of the private sector in the provision of irrigation so as to ensure full cost recovery and demand-driven service (Namara et al, 2011). Private provision of irrigation is being promoted as a solution to dwindling agricultural water security. Even though privatizing irrigation has the potential of ensuring water security, farmers has to fully pay for the services which comes with constraints that limits farmers' ability and willingness to pay, hence, their adoption of private irrigation service.

Smallholder farmers' acceptance and uptake of agricultural innovation is hindered by the cost of innovation, capital inadequacy (Thuysbaert, Beaman,

Karlan and Udry, 2011), lack of agricultural input, market price volatility, disease attack, and shortage of land (Ayoade and Akintonde, 2012). Fadare, Akerele and Toritseju, (2014) identified among others, limited inputs (fertilizer) and poor extension services as the constraints responsible for low level of agricultural technology adoption. Other constraints found to impact negatively on innovation uptake include labour deficit, credit inaccessibility, poor land tenure arrangement (Feder, Just and Zilberman, 1985), lack of technical guidance, poor marketing (Shashekala et al., 2012), poor cash flow, inadequate farm tools, and pests (Dao, Sanou, Gracen and Danquah, 2015).

Although private sector operators may find private supply of irrigation interesting, they are still faced with the uncertainty of what the challenges on the demand side might be. This calls for an understanding of the smallholder level constraints that might influence their readiness to pay to participate in the private irrigation market. An understanding of these constraints can help in predicting adoption patterns, supporting farmers to sustain the industry and designing a favourable strategy to deliver innovation (Oster and Thorton, 2009). This study therefore sought smallholder farmers' perceptions to identify and analyse the constraints to WTP for private irrigation supply in the Nandom district.

2. Materials and methods
2.1 Study Area
The study was conducted in Kokoligu, Ketuo, Brutu and Puffein communities in the Nandom district of the Upper West Region. The district is located in the North-Western corner of Ghana within Long. 2°25W and 2°45W and Lat. 10°20 and 11°00 with a total area of 567.6 square km. The district has a population of 56,090, with 95% of the inhabitants in the rural areas and 80% of the economy dependent on largely rain-fed agriculture (NDA, 2014). The main crops grown are guinea corn, millet, maize, cowpea and groundnut. The yields of these crops are poor because of erratic and unreliable rainfall pattern (Nandom District Assembly, 2014).

2.2 Sampling and Data Collection
All the four communities used in the study were selected based on their potential for irrigation development. Based on the estimated population of 170 dry-season gardeners, obtained during the reconnaissance survey conducted by the researchers, a sample of 118 dry-season gardeners was determined using Krejcie and Morgan, (1970) table. In addition, another 118 farmers who were not practicing dry-season gardening were selected as a control making a total sample size of 236.

Multi-stage technique (three stage sampling) was used in selecting 236 farmers from which primary data was collected. The first stage was selection of four small-scale dry-season gardening communities based on predefined factors. The second stage was selection of 118 dry-season gardeners from the four communities using simple random sampling techniques with proportional representation. In the third stage simple techniques was applied in selecting another 118 non dry-season farmers. The proportional representation was employed to ensure representative sampling reflecting the total number of dry-season gardeners in the four communities.

All the 236 farmers sampled were taking through in-depth interview using a semi structured questionnaire. All respondents were asked about their willingness to pay and those who were unwilling to pay were asked why they were not ready to pay. Further analysis was conducted using only farmers who were willing to pay. Preliminary contact with key informants at Kokoligu and Ketuo led to the identification of various factors that could constitute a constraint to farmers' participation in and willingness to pay for private irrigation. These constraints were prepared into a Likert type check list and presented for farmers to prioritise using the preference ranking method. Preference ranking is a technique in Participatory Rural Appraisal (PRA) where a group or individual is asked to vote on items from most important to least important, usually based on perceived relevance of each characteristic. It is very useful as it enables individuals to define their own criteria for discriminating between items and provides a large amount of information about preferences (Maxwell and Bart, 1995). Farmers were asked to rank a list of constraints presented to them with rank score of 1 being the most pressing and 14 being the least pressing.

2.3 Data Analysis
Data was analyzed using descriptive statistics (frequencies), Kendal's coefficient of concordance and chi square test. Kendall's Coefficient of Concordance (*W*) which was proposed by Maurice G. Kendall and Bernard Babington Smith was used to determine the degree of agreement in the ranked constraints to willingness to pay for private irrigation. *W* is a measure of the agreement among raters or judges assessing a set of subjects in ranked order (Legendre, 2010). It is used to assess the degree to which respondents in a study provide common ranking on an issue with same general property.

The limits for *W* must fall between zero (0) and one (1). W is one (1) when the ranks assigned by each respondent are assumed to be the same as those assigned by other respondent and zero (0) when there is maximum disagreement among the rankings by the

respondents. From the preference ranking, the total rank score for each item was computed and W calculated. The W is calculated using the formulae;

$$W = \frac{12(S)}{m^2(n)(n^2-1)-mT}$$

Where n is the number of objects, m is the number of variables and T is a correction factor, S is a sum-of-squares statistic over the row sums of ranks R_i, and R is the mean of the R_i valuescomputed first from the row-marginal sums of ranks R_i received by the objects:

$$S = \sum_{i=1}^{n}(R_i - \bar{R})^2$$

For tied ranks T is;

$$T = \sum_{k=1}^{g} t_k^3 - t_k$$

t_k= the number of tied ranks in each (k) of g groups of ties. The sum is computed over all groups of ties found in all m variables of the data table. T= 0 when there are no tied values and the equation becomes;

$$W = \frac{12(S)}{m^2(n)(n^2-1)}$$

W is an estimate of variance of the row sums of ranks Ri divided by the maximum possible value the variance can take; this occurs when all variables are in total agreement. Hence $0 \le W \le 1$
W of 1 represents perfect concordance/agreement and 0 indicates perfect disagreement in the ranking.
TheFriedman's chi-square statistic (χ^2) was used to test the significance of the W obtained. From Friedman's chi-square statistic (χ^2) is given by;

$$\chi^2 = m(n-1)W$$

This quantity is asymptotically distributed like Chi-square with *(n-1)* degrees of freedom; it can be used to test W for significance. This approach is satisfactory only for moderately large values of m and n (Kendall and Babington, 1939; Legendre, 2010) as in this study where n=236 and m=14.

3. Results and discussion:
3.1 Descriptive Statistics on the Socio-economy of farmers
Descriptive statistics estimated from the sample of 236 farmers indicated that58.5% were male respondents; average age of sampled farmers was

43.54years with a mean of 23.6years experience in farming. Farmers on average completed 3 years of formal schooling, cultivate an average of 5.6 acres and earn averagely GHc959 per year. About 54.7 per cent of the sample had access to credit from both formal and informal financial institutions, 59.7 per cent had extension contact, 48.3 per cent belong to a famer-based group and 58.1 per cent had an off farm occupation.

3.2 Willingness to pay for private irrigation
Figure 1 summarizes the result of farmers' willingness to pay for private irrigation provision. The questionnaires first asked farmers if they were willing to pay for private irrigation. Analysis of the responses gathered indicated that almost all farmers (94.5 per cent) interviewed were willing to pay to participate in private irrigation delivery.
For those unwilling to pay, major reasons for their decision were captured and depicted in the Figure 2. Most (46 per cent) of the farmers' unwillingness to pay did so because they believe it is government duty to supply irrigation. Other reasons were financial constraint (30.8 per cent), unacceptable terms and conditions (15.4 per cent) and high production cost (7.7 per cent).
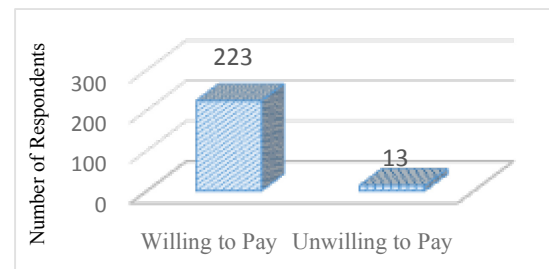

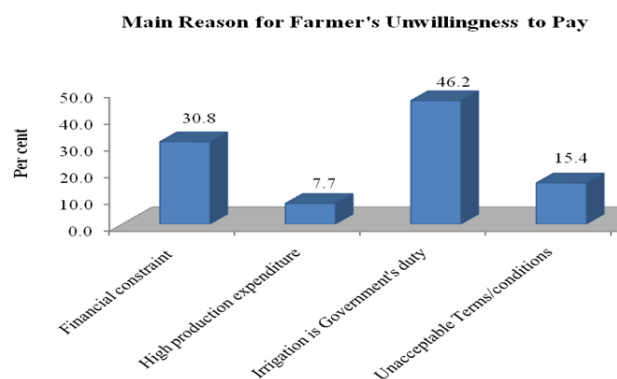Figure 1. Willingness to pay for private irrigation (N=236)

Figure 2. Main reasons for farmers' unwillingness to pay (N=13)

3.3 Constraints to farmers Willingness to pay

From key informants' interviews, we developed a list of 14 potential constraints to farmers WTP for private irrigation service, grouping them based on their commonalities. The lists were scored 1= most important to 14= least important and farmers had to rank these fourteen constraint using their own value for each. During the analysis, responses were averaged to obtain the mean rank for each constraint. Following from the way data were collected, the constraint with the least mean rank was the most pressing and highest mean represent the least pressing. The level of agreement in the ranking of constraints was determined with the Kendall Coefficient of Concordance and its significance tested with the Chi square test of significance at 0.05.

From table 1 below, the most pressing problem that could face farming in their will to pay for private irrigation market was financial constraint with a mean rank of 2.18 and the least constraining being lack of interest in private irrigation service with a mean rank of 12.39. Inadequate capital was found to be the most important constraint for the majority of farmers interviewed. Almost 60 per cent considered financial constraint as the most important constraint to their willingness to pay for private irrigation. The second, third and fourth position in the ranking of constraints were Lack of Ready Market for Output, Crop Pests and Diseases and Unstable Output Price which were the most important constraint 21, 10 and 15 farmers respectively. These finding reflects that of Ayoade and Akintonde (2012) which reveals unstable market price and insufficient financeas the two most serious constraints to adoption of agricultural innovations. Their study however found diseases and pest as the least important constraint to adoption. Other studies that concur with this findings in one way or the other are Thuysbaert, et al (2011) in their proposition that lack of capital was a major reason for non-adoption of technology in Africa; Shashekala, et al (2012) in their empirical result that found Lack of easy credit facilities, Insufficient funds, and Poor marketing as constraints militating agricultural development and Dao et al. (2015) who also found poor cash flow, inadequate farm tools, poor extension service and pests as among the main constraints to maize production. Other constraints as their level of importance declines are Costly Private Services (5.24), Inadequate Supply of Complementary Inputs (5.67), Lack of Credit Services (7.18), Bureaucratization (7. 93), Inadequate Access to Extension Services (9.62), Labour Deficit (9.77), Doubts the Sustainability of the Proposed System (10.19), Land Tenure Insecurity (10.20), Incompatible of Scheme to Crops Cultivated (11.84)

and Lack Interest in Private Service (12.39) as the least important constraint farmers will potentially encountered.

The Kendall's coefficient of concordance (W) indicated 59.6% (0.596) agreement among rankings by farmers in the district. This indicates there is some level of agreement between the rankers. Considering the fact that the closer W is to 1 the greater the level of agreement and the closer W is to 0, the lesser the agreement level.

3.4 Hypothesis Testing

Null Hypothesis (Ho): There is no agreement in the rankings of constraints to participation in private irrigation service among farmers.

From the results of this study, the Chi square analysis conducted on the ranking of constraints, the test conducted showed that there is at least 59.6% agreement. Comparing the calculated χ^2-value (1728.2) against the critical chi-value (29.819) on the Chi square distribution table with df= k -1=13 on the Chi square distribution table at 0.05 level of significance, the study therefore concluded that the agreement among the farmers in the ranking of constraints (W = .596, or 59.6% agreement among rankings) is significant and hence rejected the null hypothesis that there is no significant agreement in the ranking of the constraints.

Table 1. Constraints to farmers Willingness to pay

Constraint	Mean Rank	Rank
Financial Constraint	2.18	1
Lack Interest in Private Service	12.39	14
Costly Private Services	5.24	5
Lack of Credit Services	7.18	7
Bureaucratization	7.93	8
Unstable Output Price	4.44	4
Lack of Ready Market for Output	3.99	2
Labour Deficit	9.77	10
Inadequate Access to Extension Services	9.62	9
Land Tenure Insecurity	10.20	12
Inadequate Supply of Complementary Inputs	5.67	6
Incompatible of Scheme to Crops Cultivated	11.84	13
Crop Pests and Diseases	4.35	3
Doubts the Sustainability of the Proposed System	10.19	11

Sample size (n) =223; Number of constraints ranked=14; df=13; Rank 1=most important, Rank 14=least important; Kendall's W=0.596; χ^2(cal)=1728.2); χ^2 (tab) = 29.819; Level of sig=0.05

4. Conclusion and Recommendations

The study revealed that majority of farmers in the Nandom district are ready to pay for private irrigation provision. However, they are some key challenges that might hinder their will to pay. The most important ones being financial constraint, lack of ready market for output, crop pest and diseases, Unstable Output Price, Costly Private Services, Inadequate Supply of Complementary Inputs and Lack of Credit Services.

Financial constraint has been known to hamper the adoption of innovation in most developing countries. Three other factors that compound this is lack of ready market, unstable price for farm produce and Lack of Credit Services. They further worsen the constraint to farmers' ability to pay even under condition of perfect knowledge of the benefits that could accrue from the technology.

The study therefore concludes that the proposed private irrigation supply can be implemented to satisfy the agricultural water needs of farmers in the district since majority of the farmers are ready to pay. We further encourage implementers of the policy to deliver the service with an accompanied marketing value chain and credit services. Whereas value chain will help provide complementary inputs, ready market and stabilize prices, credit service will help improve finances by ensuring the availability of investment funding for purchase of irrigation service, and inputs for prevention and treatment of pests and diseases on the field.

References:

1) Ayoade A. R and Akintonde J. O. (2012). Constraints to Adoption of Agricultural Innovations among Women Farmers in Isokan Local Government Area, Osun State. International Journal of Humanities and Social Science, 2(8): 57-61.

2) Dao, A., Sanou, J., Gracen, V., and Danquah, E. Y. (2015). Indentifying farmers' preferences and constraints to maize production in two agro-ecological zones in Burkina Faso. Agriculture & Food Security, 4(13):1-7.

3) Fadare, O. A. Akerele, D. andToritseju, B. (2014). Factors Influencing Adoption Decisions Of Maize Farmers In Nigeria. International Journal of Food and Agricultural Economics, 2(3): 45-54.

4) Feder, G., Just, R.E., and Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A survey. Economic Development and Cultural Change, 33 (2): 255-298.

5) Kendall, M. G. and Babington, S. B. (1939). The problem of m rankings. Annals of Mathematical Statistics, 10: 275–287.

6) Krejcie, R. V. and Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, (30): 607-610.

7) Legendre, P. (2010). Coefficient of concordance. Pp. 164-169 in: Encyclopedia of Research Design, Vol. 1. N. J. Salkind, ed. SAGE Publications, Inc., Los Angeles. SAGE Publications, Inc. All rights reserved.

8) Lipton, M., Litchfield, J., Blackman, R., De Zoysa, D., Qureshy, L and Waddington, H. (2003). Preliminary Review of the Impact of Irrigation on Poverty, With Special Emphasis on Asia. FAO Retrieved from www.fao.org on January 10, 2010.

9) Maxwell, S. and Bart, C. (1995). Beyond ranking: exploring relative preferences in P/RRA; In PLA Notes (1995), 22: 28–35, IIED London.

10) Namara, R. E., Horowitz, L., Nyamadi, B. and Barry, B. (2011). Irrigation Development in Ghana: Past Experiences, Emerging Opportunities, and Future Directions. GSSP Working Paper #27, International Food Policy Research Institute, Washington D.C.

11) Nandom District Assembly. (2014).The Composite Budget of the Nandom District Assembly for the 2014 Fiscal Year. Retrieved fromwww.mofep.gov.gh

12) Oster, E. and Thornton, R. (2009). Determinants of technology adoption: Private value and peer effects in menstrual cup take-up mimeo University of Chicago.

13) Rademacher-Schulz, C., and Mahama, E. S. (2012). Where the Rain Falls Project. Case Study: Ghana. Results from Nadowli District, Upper West Region. Report No. 3, Bonn United Nations University-Institute for Environment and Human Security (UNU-EHS)

14) Shashekala, S. G., Shankaraiah, N., Sumathi, Ravikumar, P., Kavitha, V., and Govinda, G. V. (2012). Constraints of Small Farmers for Their Agricultural Development. International Journal of Science and Nature, 3(2): 442-446

15)Thuysbaert, B., Beaman, L., Karlan, D., and Udry, C. (2011). Capital constraints to technology adoption in African agriculture. Yale University and Innovations for Poverty Action April 27 2011, http://siteresources.worldbank.org/INTDEVIMPEVA INI/Resources/3998199-1285617002143/7430173-1311794476566/8074298- 1311794536164/Bram_ Thuysbaert_Thematic_Session_IIA_Theory_Evidenc e_New_Directions_capital.pdf

محدودیت‌ها در زمینه تمایل به پرداخت برای انتقال آب از بخش خصوصی در بخش ناندوم کشور غنا

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چکیده

این مطالعه به ارزیابی محدودیت‌ها در زمینه تمایل به پرداخت برای انتقال آب از بخش خصوصی در بخش ناندوم کشور غنا پرداخته است. از طریق مصاحبه با افراد کلیدی و از طریق پرسشنامه نیمه‌ساختار یافته، ۲۳۶ تن مورد پرسشگری قرار گرفتند. داده‌ها از طریق روش توصیفی و استنباطی مورد تحلیل قرار گرفتند. ضریب تطابق کندال برای تعیین سطح توافق در میان کشاورزان در زمینه رتبه‌بندی محدودیت استفاده شد. نتایج این مطالعه نشان داد که محدودیت مالی (درآمد پایین) به عنوان مهمترین محدودیت برای تمایل کشاورزان به پرداخت جهت آبیاری خصوصی بوده است. دیگر محدودیت‌های مهم فقدان بازار مناسب برای محصول، آفات زراعی و بیماری‌ها، ناپایداری هزینه‌های تولید محصول، هزینه بالای خدمات بخش خصوصی، ناکافی بودن نهاده‌های مکمل و فقدان خدمات اعتباری بود. فقدان بازار مناسب برای محصول، ناپایداری هزینه‌های تولید محصول، و فقدان خدمات اعتباری به طور مشترک منجربه نامناسب‌تر شدن امور مالی شده و توانایی آن‌ها برای پرداخت، حتی تحت شرایط دانش کامل از فواید این فن آوری، را با محدودیت مواجه نموده است. این مطالعه کاربرد خدمات آبیاری خصوصی پیشنهاد شده را توصیه می‌کند. اما مدیریت این خدمات باید یک زنجیره ارزش افزوده در مدیریت خدمات به اجرا درآورد.

کلمات کلیدی: آبیاری خصوصی، موانع، خرده مالکان