

# EVALUATION OF ENVIRONMENTAL SERVICES OF AGRICULTURE IN TAIWAN

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## ABSTRACT

*This bulletin discusses the public benefits of agriculture in Taiwan, and gives them a monetary value using the Contingent Valuation Method (CVM). Two sample groups, one of professionals working in agriculture and the other drawn from the general public, were asked hypothetical questions on how much more people would be willing to pay for rice in order to maintain domestic production in Taiwan. Both groups placed a high value on the environmental benefits of agriculture, particularly the second group.*

## INTRODUCTION

The World Trade Organization (WTO) was established, first and foremost, to eliminate various trade barriers, with the aim of promoting free trade and optimal use of resources. In pursuing WTO membership, Taiwan was forced to abolish its own trade restrictions in the agricultural sector. This is expected to lead to a sharp rise in imports, but not in exports, due to the high prices of Taiwan's agricultural products. It will threaten the very survival of agriculture in Taiwan.

The issue is an urgent one, and must be addressed. The value of agriculture should not be reduced to that of its physical production alone. Nor should a simplified international price be applied to calculate its value. Besides the economic value of its products, agriculture serves several other important functions. Policies for agricultural development in Taiwan should highlight the important roles of agriculture in rural life and the ecosystem. In short, agriculture should not be given up just because its products are not competitive on the world market for the time being.

During the WTO technical meeting on Multilateral Environmental Agreements, the

possible conflict between WTO rules and various international protocols on environmental protection was fiercely debated. In June 1999, the participants concluded that improved methods of evaluating the environmental benefits of agriculture now make it possible to measure other public benefits, and recognized that agriculture is indeed multi-functional. The remaining issue is how to evaluate more precisely the value of these functions that agriculture serves.

This bulletin aims at evaluating the social value of the environmental services of Taiwan's agriculture, by assessing the perceived benefit expressed by individual consumers.

## SURVEY OF CONSUMERS

The data is drawn from a questionnaire given to a selected pool of respondents. The survey assesses consumers' appreciation of the environmental contribution of agriculture, according to their willingness to pay for these benefits. The contingent valuation method (CVM) was used. Finally, simulation is used to give a general evaluation of the environmental services from agriculture which are enjoyed by society as a whole.

Keywords: contingent valuation method, CVM, environment, imports, rice, Taiwan

Table 1. Environmental services of agriculture

| Category    | Use value                                     | Option value  | Bequest value  | Existence value  |
|-------------|---|---|--|--|
| Description | Direct or indirect value of using the service | Willing to pay to protect the agricultural environment, to ensure future benefits for oneself | Willing to pay to protect the agricultural environment for the benefit of future generations | Recognizing and valuing the environmental services of agriculture and thus willing to pay for them |

### Survey sample

The sample surveyed belong to two groups. The first is agricultural professionals. These were full-time instructors (200 households) currently teaching at the College of Agriculture at National Taiwan University. The second group was made up of ordinary citizens, with some knowledge of agriculture or with a good general knowledge. They were either parents of students currently enrolled in the agricultural economics department of two universities (400 households) or parents of pupils attending a local elementary school in Taipei City (200 households).

Questionnaires were sent to both groups of subjects by post. The rates of return were 27%, 30% and 59% for the parents of the college students, the agricultural professionals and the parents of the elementary school pupils, respectively.

### Methodology of survey

Using the CVM approach, we began by describing the environmental functions and benefits of agriculture, to help the respondents formulate a hypothetical market in their mind. We then carried out opinion polls, to probe the views of the respondents towards agriculture. A vast amount of literature has already indicated that agriculture provides space, green land, and natural habitats, and helps retain excess rainwater and supply groundwater. All of these functions are commonly termed “the environmental services of agriculture”.

However, the fact is that although such

services are beneficial to the whole society, they are not part of any market transaction, so their monetary value is unknown. In our study, we classified the benefits from various environmental services of agriculture into the use value, the option value, the bequest value and the value of existence. Table 1 summarizes these values.

We asked hypothetical questions on how much people would be willing to pay for domestic rice per month, based on international rice prices. The questionnaire also asked the respondents to consider three scenarios. In Scenario A, the total agricultural land area in Taiwan falls by 1% from 24 to 23% (to a total of 828,000 ha). As a result, the benefits from agriculture’s environmental services fall by just under 5% (from 100% to 95.80%). In Scenario C, agricultural land falls by 20% (to 720,000 ha), allowing environmental benefits to fall to a level of 83.31%. Scenario B assumes a value between these two.

We also gathered some demographic data about the respondents. Among the group of agricultural professionals, men outnumbered women. Compared to the general public, the professionals were older, earned a higher income and were more likely to want to preserve agriculture and oppose free trade. Among the general public, there was a trend that the larger the family, the higher the monthly rice consumption per head.

### Response to trade liberalization

The non-market contribution of agriculture is often taken for granted by its

beneficiaries. Many people do not even realize such benefits exist, let alone think about paying for what they receive.

Therefore, the survey began by reminding respondents of such benefits, and the possible impact of free trade in agricultural products. It then allowed the respondents to give their own evaluation. Below is a brief summary of the views of professionals and the general concerning the environmental services of agriculture.

### TRADE LIBERALIZATION: VIEWS OF THE AGRICULTURAL PROFESSIONALS

Table 2 shows that it was a common view among professionals that the various environmental services of agriculture have great value. Only two functions, recreation and recycling of crop residues, had slightly lower recognition (88.31% and 80.51%, respectively). All other eight values listed in the Table were deemed important or very

important by more than 90% of respondents. This shows that the agricultural professionals are more at home with factors related to production or quality improvement.

It is human nature not to appreciate what one has until one loses it. Therefore, this study first reminded the respondents of the impact of free trade on the environment, to encourage them to express how willing they would be to protect agriculture. The respondents' views were then utilized as the basis on which the benefits of environmental protection could be evaluated. The results are summarized in Table 3.

Among the agricultural professionals, 64% opposed the idea that "free trade is more important than the protection of agriculture", while 66% did not agree that "environmental conservation is important, but economic growth is more important at the present time". Just over 79% of the respondents agreed with the idea that "protection of agriculture to ensure

Table 2. Perception of the environmental services of agriculture: The Professionals

| Benefits and functions  | Very Important | Important  | No idea  | Not very important | Not important at all |
|---|----------------|------------|----------|--------------------|----------------------|
| 1. Recreation, scenery, bird-watching   | 23<br>(30)     | 45<br>(58) | 5<br>(6) | 3<br>(4)           | 0<br>(0.00)          |
| 2. Conservation of resources  | 43<br>(56)     | 31<br>(40) | 1<br>(1) | 1<br>(1)           | 0<br>(0.00)          |
| 3. Flood prevention/river regulation  | 45<br>(58)     | 28<br>(36) | 2<br>(3) | 1<br>(1)           | 1<br>(1)             |
| 4. Conservation of water resources  | 45<br>(58)     | 28<br>(36) | 2<br>(3) | 1<br>(1)           | 1<br>(1)             |
| 5. Prevention of soil erosion, salt drainage, soil conservation                           | 53<br>(69)     | 19<br>(25) | 2<br>(3) | 3<br>(4)           | 0<br>(0.00)          |
| 6. Microclimate regulation  | 39<br>(51)     | 35<br>(45) | 2<br>(3) | 1<br>(1)           | 0<br>(0.00)          |
| 7. Water purification   | 45<br>(58)     | 25<br>(32) | 5<br>(6) | 3<br>(4)           | 1<br>(1)             |
| 8. Purification of atmosphere/air   | 47<br>(61)     | 26<br>(34) | 2<br>(3) | 2<br>(3)           | 0<br>(0.00)          |
| 9. Biodiversity: Providing shelter and feeding grounds for wildlife, including waterbirds | 40<br>(52)     | 33<br>(43) | 2<br>(3) | 1<br>(1)           | 1<br>(1)             |
| 10. Returning crop residues to the land   | 37<br>(35)     | 35<br>(45) | 4<br>(5) | 1<br>(1)           | 0<br>(0.00)          |

No. of valid respondents: 77. The number in parentheses indicates the percentage.

Table 3. Views of benefits from free trade vs. environmental benefits of domestic agriculture: The professionals

|  | Totally Agree | Agree      | Neutral    | Disagree   | Totally disagree |
|--|---------------|------------|------------|------------|------------------|
| Free trade is more important than protecting domestic agriculture for the sake of its environmental services   | 5<br>(6)      | 12<br>(16) | 11<br>(14) | 42<br>(55) | 7<br>(9)         |
| Environmental conservation is important, but economic growth is more important at the present time   | 1<br>(1)      | 17<br>(22) | 8<br>(10)  | 40<br>(52) | 11<br>(14)       |
| Protection of agriculture to ensure environmental sustainability is important, even if it means domestically produced foods may be more expensive than imports | 19<br>(25)    | 42<br>(55) | 8<br>(10)  | 7<br>(9)   | 1<br>(1)         |
| Agriculture contributes to environmental protection, and thus the government should subsidize agriculture  | 27<br>(35)    | 42<br>(55) | 5<br>(6)   | 3<br>(9)   | 0<br>(0.00)      |
| Agriculture contributes to environmental protection, and thus the status quo should be maintained. The area of arable land should not be reduced               | 15<br>(19)    | 36<br>(47) | 15<br>(19) | 10<br>(13) | 1<br>(1.30)      |

No. of valid respondents: 77. Numbers in parentheses indicate the percentage.

environmental sustainability is important, even if it means domestically produced foods may be more expensive than imports”, while 90% approved the concept that “agriculture contributes to environmental protection, and should be subsidized by the government”.

#### TRADE LIBERALIZATION: VIEWS OF THE GENERAL PUBLIC

The general public were less knowledgeable about agriculture than the professionals, but still showed very strong support for agriculture. Apart from the impact of agriculture on the microclimate, the rest of the items had a high approval rating, with more than 90% feeling that they were “very important” or “important” (Table 4). The difference between the two groups was not significant.

The general public’s views on the impact of free trade on the environmental benefits from agriculture are summarized in Table 5. They had mixed views about the

idea that “free trade is more important than protecting agriculture”, with 39% against, and 45% in favor. Half (50%) of respondents were against the concept that “environmental conservation is important, but economic growth is more important at the present time”, while only 38% showed approval. Clearly, the general public is rather ambivalent. On the one hand, people would like to see the environment being protected. On the other hand, the benefits from free trade are also valued. In general, it seems that the general public is less willing that farmers be paid to protect the environment, if payment is by individuals. On the other hand, the general public showed a high degree of approval for retaining arable land.

A linear bid function under three scenarios was estimated. Table 6 shows the willingness to pay (WTP) of the two groups under different scenarios. The WTP is based on the price differential between domestically produced and imported rice. The more the reduction in arable land, the higher the cost

Table 4. Perception of the environmental services of agriculture: The general public

| Benefits and functions  | Very Important | Important   | No idea    | Not very important | Not important at all |
|---|----------------|-------------|------------|--------------------|----------------------|
| 1. Recreation, scenery, bird-watching   | 48<br>(21)     | 158<br>(70) | 11<br>(5)  | 9<br>(4)           | 0<br>(0.00)          |
| 2. Conservation of resources  | 135<br>(60)    | 83<br>(37)  | 6<br>(3)   | 2<br>(1)           | 0<br>(0.00)          |
| 3. Flood prevention/river regulation  | 137<br>(61)    | 75<br>(33)  | 11<br>(5)  | 3<br>(1)           | 0<br>(0.00)          |
| 4. Conservation of water resources  | 144<br>(64)    | 73<br>(32)  | 6<br>(3)   | 2<br>(1)           | 1<br>(0)             |
| 5. Prevention of soil erosion, salt drainage, soil conservation                           | 135<br>(60)    | 77<br>(34)  | 11<br>(5)  | 2<br>(1)           | 1<br>(0.44)          |
| 6. Microclimate regulation  | 103<br>(46)    | 95<br>(42)  | 23<br>(10) | 4<br>(2)           | 2<br>(1)             |
| 7. Water purification   | 125<br>(55)    | 80<br>(35)  | 15<br>(7)  | 5<br>(2)           | 1<br>(0)             |
| 8. Purification of atmosphere/air   | 128<br>(57)    | 87<br>(39)  | 9<br>(4)   | 2<br>(1)           | 0<br>(0.00)          |
| 9. Biodiversity: Providing shelter and feeding grounds for wildlife, including waterbirds | 101<br>(45)    | 111<br>(50) | 10<br>(4)  | 4<br>(2)           | 0<br>(0.00)          |
| 10. Returning crop residues to the land   | 96<br>(42)     | 115<br>(51) | 13<br>(6)  | 2<br>(1)           | 0<br>(0.00)          |

Number of valid respondents: 226. Number in parentheses indicate the percentage.

of domestic rice, and the greater the price difference between domestic and imported rice.

On average, the professionals had a WTP value of US\$0.56 per household to have the area of agricultural land restored to its original level after a reduction of 4%. If we multiply this figure by the number of households in Taiwan, this gives us a figure of just under US\$600,000.

It can be seen that the findings from the survey of the professionals are quite different from those from the survey of the general public. The main reason probably lies in the design of the questionnaires. The questionnaires for the professionals were open i.e. respondents were asked to put their own price on the amount they were willing to pay. Questionnaires for the general public were closed i.e. they were offered a range of

prices from which respondents were invited to make a choice. Closed questionnaires often produce different results from open ones. In this survey, the values from the closed questionnaires were much higher than those from the open ones. People replying to the open questionnaire tended to give more conservative answers, which is consistent with the theory and expectations of the CVM method.

## CONCLUSIONS AND RECOMMENDATIONS

Taiwan has a dense population and a limited area of agricultural land. The island has been under tremendous pressure in recent years to use all its natural resources, including land, in pursuit of economic development. The agricultural sector occupies a large amount of land and uses other natural

Table 5. Views of benefits from free trade vs. environmental benefits of domestic agriculture: The general public

|  | Totally Agree | Agree       | Neutral    | Disagree    | Totally disagree |
|--|---------------|-------------|------------|-------------|------------------|
| Free trade is more important than protecting domestic agriculture for the sake of its environmental services   | 18<br>(8)     | 83<br>(37)  | 37<br>(16) | 79<br>(35)  | 9<br>(4)         |
| Environmental conservation is important, but economic growth is more important at the present time   | 20<br>(9)     | 66<br>(29)  | 26<br>(12) | 101<br>(45) | 13<br>(6)        |
| Protection of agriculture to ensure environmental sustainability is important, even if it means domestically produced foods may be more expensive than imports | 35<br>(15)    | 121<br>(54) | 37<br>(16) | 29<br>(13)  | 5<br>(2)         |
| Agriculture contributes to environmental protection, and thus the governments should subsidize agriculture   | 57<br>(25)    | 126<br>(56) | 22<br>(10) | 18<br>(8)   | 3<br>(1)         |
| Agriculture contributes to environmental protection, and thus the status quo should be maintained. The area of arable land should not be reduced               | 51<br>(23)    | 120<br>(53) | 29<br>(13) | 24<br>(11)  | 2<br>(1)         |

Number of valid respondents: 226. Numbers in parentheses indicate the percentage.

Table 6. Willingness to pay (WTP) for environmental benefits of agriculture  
Unit: US\$

|                              | Scenario A<br>(restoration after 1%<br>reduction in arable land) | Scenario B<br>(restoration after 2%<br>reduction in arable land) | Scenario C<br>(restoration after 4%<br>reduction in arable land) |
|------------------------------|--|--|--|
| WTP (US\$) of professionals  | 0.15   | 0.35   | 0.56   |
| WTP (US\$) of general public | 1.61   | 0.63   | 3.35   |

1US\$ =30 New Taiwan Dollars

resources, such as water. Its role has widened from giving farmers a livelihood and society its food, to sustaining the natural environment and the ecosystem on behalf of society as a whole

Taiwan's production costs are relatively high. Its domestic agricultural products have relied on protective measures to hold their

place in the domestic market. Once the local market is open to the world, and the protective measures eliminated according to the WTO rules, Taiwan's agriculture will have a difficult time surviving. This will lead to the unemployment of local farmers, the loss of their livelihood, and the decline of Taiwan's agriculture. Eventually, the

ecosystem originally sustained by agriculture will be destroyed as the sector slumps.

Countries in the Cairns Group may hold firmly to the belief that market mechanisms should be respected, and that agricultural subsidies of any kind would have a detrimental effect on the optimal use of world resources. Still, there is no reason for our discussion of agricultural trade to ignore the multifunctional features and the environmental services of agriculture. This is especially true for Taiwan, because the agricultural sector is so tied in with conservation of the local ecosystem. Damage to the natural environment is not likely to be rectified by an increase in imports. Considering how small and densely populated Taiwan is, the environmental value of agriculture should never be dismissed in such a careless manner.

The environmental functions of agriculture, such as the provision of green and open spaces and the conservation of natural habitats and groundwater, are usually called the environmental services of agriculture. The value of these is determined by the economic demand for nature and amenity in people's minds. It thus belongs to the field of non-market or public goods.

This study used the CVM evaluation method to survey, with a questionnaire return rate of 37.88%, both agricultural professionals and the general public. It came to the following conclusion.

### **Views of agricultural professionals**

Among the agricultural professionals, 91% of respondents believed that preserving agriculture to keep the various environmental benefits it provides is important or very important. Just over 79% felt that protecting agriculture in order to conserve the environment is important, even if it means that domestically produced food is more expensive than imports. Again, 90% of the respondents agreed with that the government should subsidize agriculture in order to maintain its environmental benefits. On the other hand, only 22% of the respondents considered free trade to be more important than the environmental benefits of agriculture, and only 23% felt that environmental conservation is important, but that economic growth is more important at the present time.

On the whole, agricultural professionals are evidently in favor of protecting agriculture in order to enjoy the environmental benefits it provides.

How important is the environmental benefit of agriculture anyway? How much are people prepared to pay for it? If the arable land area were to be reduced by 1% under trade liberalization, professionals were willing to pay an additional US\$0.15 per household per month for rice. If there was a reduction of 2%, they were willing to pay US\$0.35 per household per month, and US\$0.56 after a reduction of 4%.

### **View of general public**

Of the general public, 92% of respondents agreed that agriculture is very important, while 90% felt that agriculture is important for environmental conservation. Only 45% felt that free trade was more important than the protection of agriculture for its environmental benefits. Around half (50%) of the general public surveyed did not agree that economic growth is more important than environmental conservation at the moment. It is obvious that the general public are in something of a dilemma, in that they would like to see the environment being preserved, but would also like to have the benefits of free trade. Additionally, 69% of the respondents felt that protecting agriculture for its environmental benefit is important, even if it means that domestically produced foods may be more expensive than imports. Around 81% felt that the government should subsidize agriculture, to ensure environmental conservation and food security, while more than 75% considered that the status quo should be maintained and the area of arable land should not be reduced. On the whole, the general public tends to rely on the government to protect agriculture and its environmental benefits.

In terms of the monetary value of the environmental benefits of agriculture, if judged by the threat that free trade poses to the retention of arable land, most respondents gave a value of US\$1.61 per household per month for a 1% reduction of arable land to be restored to the existing level. They gave a value of US\$0.63 per household per month for restoration after a 2% reduction; and

US\$3.35 per household per month to restore after a reduction of 4%.

It is difficult to express environmental benefits in monetary terms, and the data from the study is somewhat controversial and arbitrary. However, this research has helped to give a new insight into the practical implications of current agricultural policies. It is recommended that to reach the goal for sustainable development, agricultural policies should aim, not only at the production of agricultural products or the enhancement of farmers' well-being, but also at conservation of the ecosystem.

Thus, when we have more data, agriculture policies may be promoted more effectively. After all, both the formulation and implementation of policies should be based upon a sound cost/benefit analysis. In summary, we could see the evaluation of the environmental benefits of agriculture to be in itself a good opportunity for the development of agriculture in the new century.

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