MINUTES OF MEETING
ON
PROGRESS REPORT NO.2
ON
THE PROJECT FOR CLIMATE CHANGE ADAPTATION FOR SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT IN THE COASTAL MEKONG DELTA IN THE SOCIALIST REPUBLIC OF VIETNAM

AGREED UPON BETWEEN
SOUTHERN INSTITUTE FOR WATER RESOURCES PLANNING,
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
AND
JICA PROJECT TEAM,
JAPAN INTERNATIONAL COOPERATION AGENCY

Ho Chi Minh, 12th June, 2012

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In response to an official request from the Government of Socialist Republic of Vietnam, Japan International Cooperation Agency (JICA) decided to conduct the Project for Climate Change Adaptation for Sustainable Agriculture and Rural Development in the Coastal Mekong Delta in Vietnam (the Project), which was concluded in the Scope of Work (SW) signed on April 28, 2011 between the relevant Vietnamese authorities of Ministry of Agriculture and Rural Development (MARD) and the Detailed Planning Survey Team of JICA.

Following the SW agreed upon between the both parties, JICA fielded a Project Team to Vietnam in August 2011 to conduct relevant surveys and studies for the Project. Following an official kick-off meeting, the Team had started the collection of data and information, a series of field surveys, vulnerability assessment, household economic surveys, and workshops at provincial and village levels, etc.

Through these studies, the Team has prepared the Progress Report No.2, and the presentation/seminar and sharing meeting was held on June 12, 2012 to discuss the contents of the Report. In the meeting, the Deputy Director of SIWRP made an opening speech and members of the meeting were introduced (refer to the attachment for the participants). The Team Leader and the Co-leader explained the priority issues in climate change, vulnerability assessment on the climate change impacts, draft Master Plan, identification of priority projects, and following activities, etc., and both sides exchanged comments, opinions, and suggestions as summarized below:

1) Mr. Bao Thanh (Sub-institute of Hydrometeorology and Environment of South Vietnam) appreciated by saying that the Master Plan Project has ensured the planned schedule and carried out many relevant activities as agreed. He then asked some clarifications that; 1) according to the schedule, next phase is to study the feasibility of the priority projects and to finalize the master plan, and are there any some more studies in this coming phase ?, 2) drought was ranked at 2nd priority, so was this issue considered in this the in-depth study ?, 3) the discharge of Mekong River is likely to increase in the future, and to this point is there any solution by this Project ?, 4) is the loss in VND in the climate change related damage the total loss or the only loss of paddy ?

2) *Responding the above inquiries, the team leader replied that; 1) during the next phase the surveys/studies relating to the priority projects will be carried by which feasibility will be examined, and computer model simulation is not planned, 2) 'drought' raised by farmers and also government officers who participated in the workshops in fact meant lack of fresh water, in most cases associated with saline water intrusion, and therefore measures of fresh water requirement was considered in the in-depth study e.g. in the in-depth studies of North Ben Tre and Tra Vinh, 3) though specific measures against future potential MR discharge increase were not recommended, what was pointed out in relation to the potential future increase was that the investment in the Mekong Delta should be very much careful and should not be a so-called regret investment, 4) the loss by climate change was for such commodities as paddy, trees, fruits, vegetables, and shrimp.*

3) Mr. Huan (Institute of Coastal and Offshore Engineering) requested to clarify that; 1) which year was the topographic data used in the study?, 2) climate change normally has 2 sides, advantage and disadvantage, and in the study only disadvantage side may be appearing and are there any other advantage side relating to CC ?, 3) on the measures to cope with CC, for example, measures dealing with saline intrusion in South Mang Thit or Ben Tre, there are only small-scale works and why did not the JICA team consider big-scale project like in Tien and/or Hau River, e.g. large scale saline prevention sluices in the Mekong River ?, 4) in the table of priority issues (provincial level), the 3rd issue of 'erosion and damage of sea dyke' should be changed to decrease of mangrove forest, erosion, and damage of sea dyke (page No.8 in the PPT slide), and 5) confirmation should be done on the location of Vung Liem sluice in Vinh Long (the beginning of

fresh water recruitment project in Tra Vinh province.

4) *The JICA team and SIWRP replied by clarifying that; 1) the year for the topographic map was 2008, latest version, 2) one of the advantage pertaining to CC is the availability of brackish water whereby introduction of brackish culture (shrimp culture) was proposed taking advantage side of the saline water intrusion, 3) large scale project, e.g. construction of sluices on the Mekong River has a potential risk of the project becoming so-called regret project; this is because future still remains uncertain especially dry season MR discharge might increase due mainly to i) future rainfall increase as simulated by GCM/PRECIS regional model, and ii) future hydropower dams operation in the catchment areas of MR whereby the JICA team did not recommend large scale projects on the main MR tributaries, 4) JICA team agrees to include the term of 'decrease of mangrove' into the 3rd issue of climate change, 5) JICA team is to confirm the location of the Vung Liem sluice which will be reflected in the feasibility study of the project in the coming phase.*

5) Mr. Tran Sinh (Centre of Economic Research) expressed that the Project is suitable with the context of economic transition and climate change, and the approach is sustainable. He further commented that in the development framework in the context of climate change, the priority issues reflected the real context and strategies to cope with/adapt to the issues. He questioned that; 1) the data of net profit by land use shows that fruit has a highest profit compared to other items, however between fruit, paddy and shrimp we should consider which is suitable for the coastal areas ? 2) are the priority projects in Ben Tre and Tra Vinh are typical and urgent projects?, 3) other places also have such kind of problems, for example Ca Mau or Soc Trang, so that are there any other projects for other places?, 4) on the change of cropping pattern, it should be studied deeper in terms of, e.g., what kinds of plants/varieties are suitable in the coastal area?, 5) Mekong Delta is an open and complicated system and consists of the last part of Mekong Basin, whereby in applying structural and/or non-structural measures we should consider the natural regulation (law).

6) *JICA team replied that; 1) though the fruits yield the highest profit among the paddy, shrimp, shrimp-paddy and fruits, it can hardly be extended to coastal areas since fruits are very susceptible to saline water, whereby the land use should reflect the local specific conditions, 2) Ben Tre province showed the largest loss associated with saline intrusion whereby JICA team thinks the province should be given higher priority to bring about project, and the project in Tra Vinh province can be typical one in form of recruiting fresh water from an upstream areas whereby it can be a model applicable to other areas of Mekong Delta, 3) if there is same kind of problem in other areas, now sub-sector approach project can be applicable, i.e. Saline water prevention sluice gate construction project which deals with sluice construction wherever the place is, 4) on the cropping pattern, it should be further studied and as of now there is information that IRRI has developed a new variety of paddy which can flower in early morning time whereby pollination damage by high temperature can be avoided and JICA team is to incorporate this kind of information into the MP, and 5) according to the area specific problem mostly identified by simulation, structural measures are to be introduced; however, non-structural measures can be implemented covering much wider areas though still the local situation, e.g. natural law, should be considered.*

7) Mr. Thang (SIWRR) questioned that; 1) did the simulations consider the indicators of upstream and downstream?, 2) in page 4, MK dry season discharge, the yellow line shows discharge in 2021-2030, and when comparing this line to the average line, it shows an increase of about 1,000 m3/s in January; what does the JICA team think about this increase in the next 10-20 years?, 3) about yield reduction by temperature rise, some information from his colleague shows that if the

increase of temperature under 37 oC, paddy production still increases, and only when the temperature becomes higher than 37 oC, paddy production will be decreased, 4) On the Bac Lieu project, it may not be a clear approach, saying is the change of paddy land into shrimp-paddy culture land reasonable?

8) *JICA team and SIWRP replied that future development in the upstream of MR was not considered since it is still uncertain about the future development in the catchment areas of Mekong River. Though MRC has simulated future development case, the simulation in this Master Plan project did not consider the discharge, 2) on the future Mekong River discharge which was simulated by MRC. JICA team also thinks there might be some over-estimation as an average value over 10-year period, 3) JICA team thinks that the research must have referred to the daily maximum temperature but in the Master Plan study, daily maximum temperature was not available but relied on monthly basis maximum temperature so that overall temperature rage in the presentation became lower than that researched by others, however the trend itself is very similar and the yield reduction by temperature rise should be reasonable as compared to other research results. 4) On the Bac Lieu project, the issue is not only imundation during rainy season but also over-exploitation of groundwater along the coastal areas, so that fresh water transfer from the mainland paddy area to the coastal area was examined to present an option, which was not enough. Therefore, future study in this area should be carried out, which can be in fact beyond what the JICA team can do within the limited time.*

9) Mr. Uyen (Sub-NIAPP) commented that; 1) there are many concerns around land use planning, and what was the source of the data?, 2) concerning the suggestion to change some area into shrimp culture land, the data of shrimp area should change, but the table shows the same data, 2) only sustainable shrimp culture is not enough, and it should be changed to 'cropping pattern change' and/or 'brackish shrimp culture' as a wider term, 3) in Kien Giang province, there is flood issue, but it seems that the study mainly focused on saline intrusion issue only, and is there any need to undertake flood issue?, 4) land use map employed in the Master Plan in 2008 seems to be already backward.

10) *JICA team and SIWRP replied that; 1) the source of the present land use data was provided by Sub-NIAPP, 2) the change to shrimp culture means change only during dry season but during rainy season it shall be put back to paddy cultivation, and therefore the changed area was counted in the number of shrimp-paddy area i.e. from current 47,513 ha to 194,976 ha, 3) since saline intrusion was ranked at the 1st priority amongst the climate change issues, saline prevention and/or saline water adaptation means were given highest priority in the Master Plan, and on the flooding issues, increasing of drainage capacity is very important which is to be funded by an World funded project in southern part of Mekong Delta while in northern part of Mekong Delta, ADB funded project is now planned so that the JICA Master Plan did not put much emphasis on the flooding issue, 4) provided that there is updated land use map, the future land use planning will refer to.*

11) Mr. Vuong (Southern Sub-Institute for Forest Inventory & Planning) raised that; 1) flow regime in Ca Mau is very complicated, and it depends on different tidal regimes of West and East Sea, in addition, there are many conservation places in Ca Mau, so that this project idea in Ca Mau might not be feasible, 2) "Improvement of mangrove forest" should be changed to "rehabilitation of mangrove forest".

12) *JICA team replied that; 1) the issue in Ca Mau peninsula is that the area cannot receive fresh water from Mekong River whereby there are shrimp diseases occurring very often, and therefore as one of ideas of improving water environment such idea of utilizing the tidal regime was proposed., 2) the "Improvement of mangrove forest" will be changed to "rehabilitation of*

mangrove forest" from the next report.

13) Mr. Trong (Research Institute for Aquaculture No.2) commented that; 1) "shrimp" culture should be changed to "aquaculture" because not only shrimp but also other krill are raised by farmers, 2) There is one project of NACA (2010) about aquaculture in Mekong Delta, which shall be referred to by this Master Plan project, 3) in paddy-shrimp rotation, it is difficult to choose a good and marketable paddy variety, indicating that there may be a good saline adaptive paddy variety which should be considered in the plan, and 4) in Ninh Quoi area (Bac Lieu), there is a conflict between fresh and brackish culture, and therefore the change of land use should be carefully considered.

14) JICA team replied that; 1) the term of "shrimp" culture will be changed to "aquaculture", 2) outputs of NACA project will be reviewed and referred to in the Master Plan where applicable, 3) though there is already salt tolerant variety of paddy, unfortunately the yield is not high so that in most cases farmers hesitate to introduce it, instead it may be suitable to introduce brackish aquaculture, 4) the proposal in Bac Lieu is one of the options, so that the Government should decide amongst the options including the one proposed in the Master Plan.

As a concluding remark, Mr. Hien, Deputy Director of SIWRP, expressed that there are many difficult and complicated issues in the coastal Mekong Delta; e.g., since discharge at Kratie is the inflow of the model, it will affect water flow regime in the Mekong Delta as well as the forecasts and measures. On the other hand, the development in the catchment areas of Mekong River is also very important, especially hydropower dams and their operations. On the change of the land use, for example, in Bac Lieu, it is not feasible because there is a project called "project on demarcation of fresh and saline areas" before and there are many hydraulic works already in place.

Through this meeting, we can see that the Project Team has studied many projects and issues, so that they selected and recommended the most suitable priority projects as we can see in the following activities. As known, there are still many arguments about measures for coastal Mekong delta. We hope that the team can recommend the master measures, new ideas for this area since Japan is very famous in coping with climate change. He once again thanked all the participants for the meeting having lasted as long as four and half hours, and officially closed.

Participants to the Progress Report No.2 Presentation Meeting, 12th June, 2012

Southern Institute for Water Resources Planning

Mr. Nguyen Xuan Hien	Deputy Director
Mr. Nguyen Huu Tan	Head of Technical and International Cooperation Division
Mr. Nghiem Dinh Thanh	Head of Mekong Delta Planning Division
Mr. Dang Thanh Lam	Director of Hydrology and Water Resources Division
Mr. Tran Ky	Deputy Director of CC-DR Centre
Mr. Pham Gia Hien	Director of COWQE
Mr. Nguyen Thien Cam	Deputy Head of Mekong Delta Planning Division
Mr. Nguyen Tri Phuc	Head of Administrative and Human Resources Division
Ms. Melita de Vries	Australian Volunteer
Ms. Nguyen Thu Ha	Technical and International Cooperation Division
Mr. Le Viet Minh	Mekong Delta Planning Division
Ms. Dang Thi Thuy Hang	Climate Change and Disaster Responses Centre

Related Organizations/Institutes

Mr. Tang Duc Thang	Director of Southern Institute for Water Resources Research
Mr. Le Xuan Bao	Deputy Director, Institute for Water and Environmental Research
Mr. Le Quy Vuong	Southern Sub-Institute for Forest Inventory and Planning
Mr. Tran Sinh	Director, South Vietnam Economic Studies Center
Mr. Nguyen Van Trong	Deputy Director, Research Institute for Aquaculture No.2
Mr. Hoang Van Huan	Director of Institute for Coastal and Offshore Engineering
Mr. Bao Thanh	Director of Sub-Institute Hydrometeorological
Mr. Nguyen Trong Uyen	Deputy Director Sub-NIAPP, Sub-National Institute of Agricultural Planning & Projection
Mr. To Quang Toan	Southern Institute for Water Resources Research

JICA Liaison Office in HCHM

Ms. Phan Thi Thanh Truc	Senior Assistant

JICA Study Team

Mr. Kosei Hashiguchi	Team Leader / Rural Development Planning
Dr. Motoyohsi Hikasa	Co-leader / Irrigation & Drainage / Rural Infrastructure
Ms. Miki Takahashi	Secretary/ Agriculture (Paddy Cultivation)

MINUTES OF MEETINGS
ON
DRAFT FINAL REPORT
ON
THE PROJECT FOR CLIMATE CHANGE ADAPTATION FOR SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT IN THE COASTAL MEKONG DELTA IN THE SOCIALIST REPUBLIC OF VIETNAM

AGREED UPON BETWEEN
SOUTHERN INSTITUTE FOR WATER RESOURCES PLANNING,
MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT
AND
JICA PROJECT TEAM,
JAPAN INTERNATIONAL COOPERATION AGENCY

Ho Chi Minh, 1st, February, 2013

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In response to an official request from the Government of Socialist Republic of Vietnam, Japan International Cooperation Agency (JICA) decided to conduct the Project for Climate Change Adaptation for Sustainable Agriculture and Rural Development in the Coastal Mekong Delta in Vietnam (the Project), which was concluded in the Scope of Work (SW) signed on April 28, 2011 between the relevant Vietnamese authorities of Ministry of Agriculture and Rural Development (MARD) and the Detailed Planning Survey Team of JICA.

Following the SW agreed upon between the both parties, JICA fielded a Project Team to Vietnam in August 2011, and the Team has been carrying out relevant surveys and studies including vulnerability assessment on the climate change, household economic surveys, workshops at provincial and village levels, master plan formulation, in-depth study on the typical issues relevant to climate change, identification of priority projects, and feasibility/detail study for the priority projects, etc.

Through these studies, the Team has prepared the Draft Final Report, and the presentation meeting was held at Can Tho city on January 28 and at Hanoi city on January 30 inviting relevant officers listed in the attached paper to discuss the contents of the Report. In the meetings, the Vice Minister of MARD, Mr. Hoang Van Thang, delivered an opening speech, and welcomed all the participants for attending the meetings and gave an overview of the study. Following the Excellency's speech, Mr. Ishida, Representative of JICA HCM office delivered welcoming speech while in Hanoi presentation meeting, Ms. Ui, Representative of JICA Vietnam office, gave welcoming speech to the participants.

His Excellency also chaired the two meetings, during which the JICA team leader made the presentation on the draft final report at the beginning including recommendations to the MARD as well as to the participant donors and then all the participants have had fruitful knowledge and information exchange.

I. Presentation and discussions at Can Tho (January 28, 2013)

Mr. Tien, Phó Cục Trưởng Cục Quản Lý Xây Dựng Công Trình- title: Vice-Director of State Department of Construction Management, raised following comments:

1) In the draft final report, three are climate change assessment, prediction and vulnerability assessment. Ground on these 3 key issues, the JICA Team has established a mater plan. Then, issue No.4 and No.5 relate to priority project identification. Issue No.6 is about feasibility study. For each of the first 3 issues, the Team has given their assessment in a relatively full scale. We say it is very accurate and informative. However just base on these 3 issues to select the priority projects in issues of No.4, No.5 and No.6, the work might seem still to have some shortage. It means the combination may be needed between all issues relevant to climate change. A master plan could not just set foundation purely on the climate change assessment, prediction and vulnerability assessment; rather it needs to incorporate the following matters; 1) first the matter how countries have been using water in the MK upstream should be considered, 2) secondly, it needs consideration of domestic usage of water resource by the people living in the MK delta, 3) consideration of plantation diversification, and 4) consideration of infrastructure development, especially the recent urbanization trend. All of those aspects if incorporated into the master plan will reflect a better-scale impact to the socio-economical development of the Mekong region. We may say that it would be better if it is to incorporate these issues. One more significant aspect of impact is the groundwater usage, its consequent subsidence and the urban ground subsidence trend. The delta subsidence, which is not however the urbanized ground subsidence, is at moment quite critical. These factors all affect the socio-economical development of the MK region, and give impact to foreign investment attraction, to infrastructure development, and so on.

2) The second comment is about the priority projects. When identifying the priority, it is a must to core it in a whole Mekong delta dimension. Where there is one project of very high priority in

view of its single value, there still have projects of big impact to the whole regional development. For example the Cai Lon – Cai Be sluice gates project may not create a big impact to the only each provinces of Kien Giang, Bac Lieu, and Ca Mau. However this project gives a potential influence to all South Ca Mau Peninsula provinces. In my opinion, the Cai Lon – Cai Be sluice gates project needs to be placed as top priority in purpose of supplying fresh water to the Ca Mau Peninsula provinces. If not, they still use the only water source from rainfall.

3) One more comment is to very much agree with the approach the JICA team developed, which is the monitoring and evaluation with feedback in a periodical view. The monitoring and feedback will help develop appropriate view of the strategic mid-term and long-term targeted development of Vietnam.

Reply from JICA Team: Since the Master Plan study centers on agriculture and rural development sector, the team focused more or less on the agricultural and water resources development, not much including socio-economic development perspectives. If we had incorporated socio-economic point of development including industry development and road network development, the master plan would be more comprehensive while losing some critical points in the sector of agriculture and water resources. In this sense, there should be a linkage with other regional socio-economic development plans, e.g. Delta Plan now being finalized with assistance from Netherlands government. On the big scale project, the Team thinks that no-regret investment is the most important issue since the future is not 100% sure, always entailing uncertainty. Therefore instead of proposing a big project, e.g. Cai Lon – Cai Be project, the team proposed a series of reasonable scale projects.

Mr. Le Khac Tung, Cục Trồng Trọt Phía Nam- Southern Plantation Department, raised following comments:

1) Firstly I agree with the approach of the assessment. When we have an incorporative assessment of multiple factors like temperature rise, flood, and rainfall, normally we often fall into negativity assessment only. The flood also brings some positive impact to Mekong Delta. If rainfall increases, flooding would contribute to preventing salinity intrusion.

2) Next issue is the vulnerability assessment focused on the salinity intrusion only and not on each category of produces like paddy, or fruits in Ben Tre. While in reality the economy of Ben Tre does not only base on paddy but much largely on orchard. Currently, Ben Tre enjoys a safe paddy production due to a round closed dike system to prevent salinity. However, this dike system is creating big impact to the fruit economy further inward of Ben Tre land. The Master Plan study centers on agriculture production but was developed on paddy produces, not much considering other commodities.

3) In my opinion, solution and suggestion might seem not highly compatible yet. For example salinity intrusion and temperature rise are assessed to increase and then solution is a time shift from October into November or may further move to December. In this matter I feel why solution after assessment seems somehow inappropriate to our reality. I rather think of salinity intrusion the other way on the Winter-Spring crop by moving crop calendar earlier to avoid salinity which happens at end of crop season. Our reality of paddy production at the coastal provinces confronts salinity intrusion at the Winter-Spring crop end, not at the crop start.

Reply from JICA Team: the delay of the winter-spring paddy is due to the increased rainfall at the end of rainy season. The delay of the commencement of winter-spring paddy inevitably puts the cropping calendar into March and April. Therefore, the JICA Team proposes to introduce short maturity variety of paddy in order to escape from the saline intrusion which in most cases happens at the end of the crop season.

In response to the above comment, a participant from Ben Tre DARD said that they in coordination with the SIWRP officers and JICA Team members participated in the site check for reality data, and they agree with the Master Plan report information. Further in response to (Mr. Tung's) the comment about Ben Tre economy, the participant said Ben Tre has Ba Tri district with 10,000 more hectors for paddy fields, which are suffering lots of salinity intrusion. About the priority for sluice gate project, Ben Tre therefore should know that sluice gate construction is of very high priority.

The participant from Ben Tre further continued that Ben Tre project has very high priority because of not only salinity intrusion prevention but also helping water supply to domestic usages. Location of Ben Tre encounters 4 rivers crossing, whereby salinity intrusion is quite evitable. Over the 4/1000 (unit) of salinity level takes place especially in drought season of March lasting to May. In this dry period of time, sometimes salinity has intruded 60 km upward into Ben Tre district from the river estuaries. Moreover, Ben Tre is different from the other provinces that they have almost no ground water resources. There is a range of aquifer running from Long An down to Tien Giang and links to Chau Thanh district (at Tien river) of Ben Tre province, staying at a limited resource which allow maximum pumping of 8,000 cubic meter/ day only. Currently Ben Tre uses this resource in emergency time only, for example, pumping it into the reservoir of water supply companies to reduce salinity degree in water supply. In brief, this Ben Tre project will play more than a help to the economy of paddy and fruit only, but the problem of water supply for around 600,000 population will also be solved. Therefore, Ben Tre province supports the North Ben Tre project as proposed by the JICA Team.

Vice Minister Hoang Van Thang asked Ben Tre if they have any actual research or assessment for ground subsidence? Response from Ben Tre is that there is not yet such study for any ground subsidence issue. Ben Tre is exploiting groundwater due to limited resource, but not to the unlimited level. Mostly Ben Tre uses the groundwater for (1) emergency situation, and (2) for exceptional aqua-fish enterprises and specifically as a means to farming aqua-products only. Ben Tre does not permit any other usages. At the other coastal areas there are either 1 or 2 small aquifers but Ben Tre keeps it only in case of people's life emergency and the supply lasts just few days shortly. Therefore, it can be said that Ben Tre mostly does not exploit much of the ground water at this moment.

Mr. Nguyen Van Hoa, Viện Cây Ăn Quả Miền Nam- Institute of Southern Fruits and Orchards, raised following comments;

1) In our history of study, we have performed a combined fruit between Cây có múi (Jack-durian species) và cây xòai (and mango tree) and the result was quite fruitful. I agree with Mr. Tung's opinion on vulnerability assessment scale, not just focusing on paddy only becouse fruit economy is very potential. Fruit trees grow by years to mature, but quite easily get affected by salinity intrusion. Under scenario of 1-2 month water inundation, fruit trees will die in contrast to years of growth. Fruit trees require long-term investment. Ben Tre has popularly grown rabuttan trees, longan trees, and durian trees and in wet season farmers there usually reserve water in big plastic bags and maintain in ponds to use it during saline intrusion season. I am very much agreeable to the sluice gate project as solution to this water supply crisis.

2) In addition, next investment would be a study of developing saline-resistant fruit trees for long term fruit economy development. The situation of Ben Tre will not just stay at Ben Tre only on the long run, rather Tra Vinh, Tien Giang and other provinces may confront this same issue. Therefore, we need a study of developing saline-resistant fruit trees for long term fruit economy development.

Mr. Hồ Văn Chiến, Giám Đốc Trung Tâm bảo vệ thực vật phía Nam- Director of Plant Protection Department, Southern Office, added the following comments;

1) This report presents through factors of climate change impact: temperature rise, salinity intrusion and rainfall increase and further developed a very good master plan with a positive view. Looking into the result, however, between Ca Mau and Kien Giang the temperature gap is in fact big though they are neighboring provinces. Is there any reason for that situation?

Reply from JICA Team: The biggest temperature rise takes place at a southern part of Ca Mau province near coastal area while smallest temperature rise happens at a northern part of the Delta. Therefore the temperature gap between the two provinces is big despite the fact they are located side by side.

Mr. Nguyễn Văn Trọng, Viện Nghiên Cứu Nuôi Trồng Thủy sản 2- Research Institute for Aquaculture No. 2 (RIA2)), gave following comments;

1) The report shows some negativity of climate change. However the potential of aqua-fish industry can enjoy part of this situation like the "saline adaptable fish - cá nước lợ" farming. I hope the assessment should include aqua-fish economy to have a better perspective of evaluation since people can exploit circumstantial adaptability. Another notice is about solution. Mostly in this report we see major construction projects to build to protect, to prevent but not much on to adaptation. Another opinion I want to add, as it was said before here, is that verification of products is necessary. It should not just focus on shrimp only, but beyond shrimp, we can have loài nhuyễn thể (soft-body (squid) creatures), brackish fish, etc.

Reply from JICA Team: One of the projects proposed in the Master Plan is sustainable shrimp culture promotion program, and this program includes not only shrimp culture promotion but also other brackish fish cultivation.

A Tra Vinh representative gave following comments:

1) We agree to the report and priority project scheme. Tra Vinh project, Nam Truong and Nam Mang Thit sub-project, enjoys almost closed dike system but still needs 2 sluice gates at (provincial) upstream of Tan Vinh and Buu Quoc at the Hau River and Tien river. In recent years, Tra Vinh confronts severest water crisis by the end of Winter-Spring crop and also start of Summer- Autumn crop. In these 2 months, the 2 neighboring crossing streams got salined deep further up to the boundary with Vinh Long province. In this critical period, Tra Vinh only can source fresh water from a stream at Vung Liem river of Vinh Long province which stays not salined yet (currently). In this severe situation, Tra Vinh province so urgently needs this project and this also is a message of request by our Mr. Quoc (from Tra Vinh People's Committee) and therefore speed up of this priority project for Tra Vinh is highly requested.

Vice-Minister Hoang Van Thang asked Mr. Hien, Director of SIWRP, the followings; I have met Viện Nghiên Cứu Tai Bien Địa Chất working in Cà Mau, and there the Norwegian Ambassador informed me of a 5.5cm subsidence (possibility), and in technical report by local staff it pointed out a 3.9 cm subsidence. This figure reveals already big concern. Our climate change prediction sets up periodical sea level rise at 8 cm for 10 years; however now the subsidence may occur at 3-4 cm per year which is quite significant. What happens taking into account the ground subsidence in future?

Mr. Hiền, Viện Trưởng Viện Thủy Lợi Miền Nam- Director of Southern Institute of Water Resource Plannning, delivered the following replies;

1) For this master plan project of 7 coastal provinces, we have first based on a whole Mekong area perspective to establish our project framework and studied the upstream water resource information. However, as commented by Mr. Tien about our shortage in a full-scale view of whole MK region, I would like to clarify, in this plan, we have developed water resource

management on the whole Mekong delta region including the upstream boundary water resource situation at point of Krache and our (upstream) calculation grounded on MRC master plan. We have applied their B2 climate change scenario.

2) During the project collaborative work with JICA, they have first interest in projects of emergency measures for now. For the other projects like Cai Lon – Cai Be sluice gate project, even if we have enlisted it, due to some environmental and ecological issues JICA suggested to move it to a later phase. For this time, we agreed to priority projects to help completing our urgently needed projects Ben Tre and Tra Vinh.

3) In this plan, we have not included ground subsidence study due to many reasons. In some provinces without enough surface water like Ca Mau and Bac Lieu, intensive and semi-intensive shrimp farming are growing quite fast over-exploiting groundwater. As the implication from a recent Norwegian-funded research, it may happen that depth of subsidence goes far to 3- 5 cm per year. And this information is quite shocking to us about ground water resource and usage. In this plan, as we have not placed this subsidence assessment, we must consider studying this subsidence possibility in future study.

4) The damage caused by land subsidence becomes much bigger than the risk of sea level rise at the present. And so at this workshop I would like to suggest the Minister office to promote such study not just to stop at the Norwegian project but we should continue developing our own research to assess the ground water resource and usage at each area. I think the subsidence level should provide distinctive results at different provincial realities. For example, Ca Mau, Kien Giang, Bac Lieu, Soc Trang may have used groundwater critically; however Tra Vinh or Ben Tre have limitedly used aquifers. Therefore what we need is the Ministry to organize for us to develop scientific research at these areas to explore the actuality and then we can think of emergency solutions to stop this subsidence threat.

5) In response to the comment of Cuc Trong Trot, in deed this plan studies on multiple dimensions not just singly on paddy economy. We have not got all information through the Team Leader's presentation but the research has included vegetables, fruits, aquaculture and forestation as well. The participants should all see the big volume of information in these thick reports which were just presented in a short time in this occasion. In fact during this seminar it seems for the JICA team impossible to cover all through but almost all the issues raised are answered in the reports.

6) Beyond the negativity of climate change impact, JICA team leader also takes into account positive impact of climate change. For example, when the water level rises, at some areas it causes high water level facilitating stream flow, ie. Tien Giang, Vinh Long and the upstream of Tra Vinh, Ben Tre. Also there is assessment of sea level rise which will sequentially raises the groundwater level which positively helps reconcile the pH level of soil in the drought season through oxidizing process promotion while waiting for rain to come.

Vice-Minister, Mr. Hoang Van Thang, replied that Mr. Hien's clarification is clear at Ben Tre and Tra Vinh groundwater usage. Even the ratio is not significant due to limited use, however we need to keep monitoring groundwater resources at Ben Tre and Tra Vinh. And so far the projects at Ben Tre and Tra Vinh may get right priority to promote the soonest.

Mr. Hoang Huan, Viện Trưởng Viện nghiên cứu Biển- Institute of Marine Environment and Resources (IMER), gave following comments;

1) We have had some work on this JICA master plan project for the 7 coastal provinces. I have thought protection promotion. For any reason, we need to consider on nation sovereignty vs. coastal land erosion. We need to protect our land resource. On this viewpoint, we have

collaborated with the JICA Team on status review, and sea level rise prediction which directly causes erosion. For every cm of sea level rise, it can drive multiple impact of land erosion. The higher water level is, the stronger wave force becomes. And this plan mentions this interaction quite clear enough. In their plan of river flow simulation, for example at Tra Vinh coastal line, the wave has increased by 0.5 meter compared to the last 10 years.

2) From this figure, it shows a reality of all coastal line in the Mekong delta is getting strongly invaded, and the West Sea area also suffers. The west sea land no longer enjoys sedimentizing ground as it used to. Previous trend of sedimentation lost, and new trend of erosion has initialized. To Tra Vinh coastline, there was no land erosion back to the past 10 years, but now, Tra Vinh is suffering 3 points of this phenomena at Chau Thanh, Long Hoa and Ngoc Thach. Tien Giang also suffers some at the length between Soai Rap down to the estuary (1:50:14). In Ho Chi Minh city, thanks to sea dike system, their coastal land gets protected from erosion. If you could see wherever coastal area has sea dike construction, their land gets reserved. For example Tra Vinh has a length of 1,400 meter sea dike at Tay Ngoc Thach and now the land there still stays.

3) The second issue is the estuary and sedimentation process assessment. There has sedimentation; however the assessment has not been well conditioned to develop. We don't have assessment of the estuary distortion. I suggest we need to develop a study of this matter, since estuary plays critical role in land, river and ocean transportation.

4) The 3rd comment is on the sluice gate to prevent salinity intrusion. I think the plan design in considering the whole Mekong region climate change is appropriate to point out the three priority areas. Other projects like on Lon river, the sea dike system for Go Cong- Vung Tau, for Kien Giang etc. can not get promoted in these projects scheme and may wait for later then.

Mr. Thanh, Viện Khoa Học Công Nghệ VN, Vietnam Academy of Science and Technology, said that;

1) This master plan is the first in Vietnam in category of climate change adaptation which covers enough elements such as temperature rises, sea level rise, rainfall with prediction focused on the 7 coastal provinces of MKD. It is informative. And solution proposed is in fact reasonable. Priority projects got identified. One of the critical project researches is the promotion of the water flow in Ca Mau peninsula. The flow is problematic in Ca Mau. Because of its location between seas, the province suffers variety of tidal regime. Water just stays for long.

2) A comment is on the data of water flow simulation of Mekong river. The results which the future water flow will increase in dry season in future may need to go through check or ask for evidence. Because I have read the recent data on the water flow of MR in January and February, which all slows down and salinity intrusion is increasing.

3) Next comment is on solutions. The plan focuses on salinity intrusion prevention, and not on tidal intensification and sea level rise. However, recent and current alarming problems root from sea level rise and strong tidal regime higher than salinity cause.

4) Next is about fresh water recruitment for Tra Vinh. The project is important and necessary as priority project for its population. However Tra Vinh locates between the 2 Tien and Hau rivers, where surface water is still better available than in the Ca Mau and Bac Lieu. They are naturally confronting a longer distance to river and quite in shortage of fresh water that drive people to over-exploiting aquifers and cause subsidence.

5) And one more critical need which should be of top priority is the sea dike system. Because dike serves many functions: protect land against sea level rise, transportation and so urbanization process can also be facilitated through this facility better. Or else plan should pay attention to

solution of protective forest range along coastline to protect our land.

Reply from JICA Team: As mentioned before, future is uncertain. MR discharge may increase due to the increase of rainfall in future. MR commission has also simulated future MR discharge to increase. However, this is to be influenced by the development of upstream catchment area including the construction of hydro power dams. Therefore the basic point the JICA Team proposes is not to implement regret investment, rather do the development step by step whereby leading to no-regret investment. For the sea dyke, there is a project called river dyke construction/rehabilitation project. This project design referred to the simulation results which identified, together with field assessment, the areas to be eroded and/or deposited. In considering these trend in future, erosion or sedimentation, 5-6 types of the dykes were proposed in the master plan.

Mr. Trung, Can Tho University commented that the hypothesis was based on the MRC plan to simulate water quantity, and the result is more down in the dry season and thinner in wet season due to the upstream dams operation. This result is correct in years of normal operation circumstance. Our university has collaborated with the CSRA (Australia) and Vietnam Academy of Science and Technology, and we have new hypothesis that in drought year dams can not optimize their operation, so that regional scenario becomes very severe, salinity intrusion become critically intensified.

Mr. Cao Van Phung, Vien Lua dong Bang song Cuu Long- Cuu Long Delta Rice Research Institute-CLDRRI, gave the comments that this master plan focuses on trends of climate change, predictions and solutions in the sector of agriculture production. In brief, we need a symmetric view on construction or non-construction investment and also between solutions and size of finance for the society advocacy. As an example, O Mon - Xa No projects constructed hundreds of sluice gates but were left less effectively used. People do not see changes after the project investment. Plan needs to take account economical (shrimp farm, diversified crops) and social benefits (better quality of life), management improvement, effectiveness, and so on.

Mr. Vice Minister, the chairman, concluded that the seminar solicited many comments from levels of province, region, and academic institutes. This JICA study research and master plan are of deep and informative study; however within seminar time frame the volume of facts and figures stay beyond full understand. This research helps building a good MKG vision to 2050, whereby it is a good approach. We should refer to the last page to understand the key concepts: flexibility and no-regret investment. Solving all problems is impossible. Offering solutions to the MKD problem is feasible. Climate change impact is huge. Especially drought, salinity intrusion and flood are significant. Water is the core concern of Mekong delta development. We therefore suggest stakeholders to keep on thinking, studying and send more feedbacks to either 1) Vien Qu I Hoach Thuy Loi Mien Nam (Southern Institute of Water Resource Planning, or 2) Tong Cuc Thuy Loi (National Water Resource Management)

Mr. Vice Minister further suggested to JICA a combined project from 2; Ben Tre – Tra Vinh into 1, and he requested to JICA to keep on funding researches on 1) coastal protection identification and measures, 2) Cai Lon and Cai Be sluice gates on Lon river, 3) water flow improvement for Ca Mau peninsula, 4) water recruitment for Ca Mau, 5) Bac Lieu to reduce groundwater exploitation for aqua-fish production. He enlightened that the other academic institutes of Vietnam should also continue thinking for Mekong delta development, e.g. right products for right location, production diversification, the approach of how to develop, "road map" for development. He finally thanked JICA and officially closed the session.

II. Presentation at Hanoi (January 30, 2013)

Vice Minister of MARD, General Director of Water Resource Directorate, Mr. Hoang Van Thang shared with the participants the followings;

1) This workshop in Hanoi was organized by JICA and MARD, and just 2 days ago in Can Tho city, same workshop was arranged and it draw the interest of many concerned agencies. He further stated that the Coastal Mekong Delta region is the main area for production of rice, fruits, fishery (shrimp cultivation), contributing largely to the domestic and export needs.

2) His Excellency further continued that the study area accounts for 10% of the total area of Vietnam, and it has become more vulnerable to the climate change. How can we come up with good measures against saline intrusion, especially in Ben Tre province where there is more severe drought and saline intrusion thereon? Other issues are that the sanitary condition is getting worse, inundation and flooding at other places at a part of Ca Mau peninsula getting worse, erosion and subsidence of land as well. In addition, increase of temperature will reduce paddy production, and also flooding in rainy season will affect agriculture production. Upstream area's hydropower projects would reduce sediment, so that mangrove would be affected. Flooding may give benefit to the some areas, but some areas are not.

3) The flooding risk becomes more remarkable and local people have taken various measures including sandbag to prevent floods. Many coastal areas including Ca Mau peninsula has been affected largely and severely by saline intrusion and also erosion. It is identified that the cause comes from both the upper part and internally: in the upper part, many hydro-powers schemes have been constructed whereby reducing the discharge flow and the water volume in the lower part, decreasing the alluvium sedimentation in the lowland region, causing the decrease of fishery source on the other hand, more saline intrusion, and inundation.

4) According to the simulation of a Norwegian Research Institute, Ca Mau peninsula will be inundated in 20 years. However, this water management related issue in the delta region can't be solved just by province, but should be undertaken regionally and nationally. The ground subsidence and the exploitation of underground water are now causing big challenge.

5) This Mater Plan study report prepared by Sanyu Consultants Inc. explains a lot to us, and points out what to do in the coastal Mekong delta region. MARD also thanks for the international support from Japanese Government, the Government of Netherlands, the Norwegian Government, the Ausaid, etc. There have been a number of studies in the Mekong delta region. Mr. Thang, vice minister of MARD, expressed their appreciation to the supports from JICA in carrying out this study. He thanked the participants' interest in this workshop which will provide a scientific approach with both structured and non-structured measures to address the arising problems in the coastal Mekong Delta region.

Following the opening remarks by the vice minister, Ms. Ui, Representative of JICA Vietnam gave a speech on behalf of JICA Vietnam Office as follows:

1) She expressed her thanks to MARD and SIWRP for organizing this workshop by this busy time of the year. The Project for CCAP-MD is under the TA agreement signed between JICA and Vietnamese Government in April 2011. She further reminded the participants that the objective of the Project is to present "Climate Change Adaptation Solutions for sustainable and rural development in the coastal areas in the Mekong Delta region. Vietnam has taken many counter-measures, to which the JICA project team also conducted simulations and surveys. This study will therefore share the result of surveys, summarized as the master plan with priority projects.

Mr. Mori, JICA Expert of the SPRCC Project to MONRE expressed his thanks to MARD for their support to this master plan project. He also expressed his appreciation to SIWRP and the Project team for the presentation which showed the situation in the area. He raised issues such as; what is the criteria set to prioritize activities in the region, how to coordinate with WB & MPI activities in the region. How to respond to the CC in the longer-term from the regional point of view. How about the land use issue which requires the inter-ministerial coordination.

Mr. Nguyen Viet, Deputy Director, Planning Department, General Directorate of Water Resource highly appreciated the study results. He then has 2 issues to be raised: Page 9 of the presentation on structure of the MP framework does not show any Adaptation/Coping strategy to address the flood inundation issue which is important one in the context of the sea level rise. On the page 6 of the presentation, sea level will rise by 8-9cm over 10 year period; however this is still uncertain. The MR discharge might increase in the future. How the Project deals with such issues of not only saline intrusion but also what were mentioned above.

Mr. Hashiguchi, Team Leader of the Project replied as follows:

1) Criteria for prioritizing activities for CC issue were given by the Government officers and the villagers. They spoke out their practical problems and voted the CC issues in the public meetings. The selection criteria for the priority project are indicated in Page 10 of the Presentation.

2) On the long-term development aspect, the master plan Project showed the simulation up to 2100, and the plan up to 2050 divided into phases with annual review for improvement of the master plan.

3) On the land-use, the JICA study proposed a future adaptable land use plan taking into account future saline intrusion as well as future flooding to be intensified. There are in fact areas where not only paddy but also brackish shrimp culture can hardly be established. This is because if the saline level is between 1500 PPM to 10,000 PPM, paddy can hardy be grown whereas shrimp culture does the same. For such areas, the land use plan becomes the most difficult where the JICA Team recommended structural measures to protect present paddy cultivation.

4) The JICA Team undertook not only saline intrusion but also flood control. One of the examples of flood control is to construct ring dykes in Tien Giang province where there are a lot of floods. In addition, some of the sluice gates were introduced not for the purpose of saline intrusion prevention but for flood mitigation.

5) On the MR discharge, in future, it is predicted that the rainfall increase shall increase the discharge, and then it might address the saline intrusion to become less than the present. However, as aforementioned future is always uncertainties and this is the reason why the JICA Team recommended that the investment should be done step by step whereby we may be able to avoid regret investment.

Vice Minister Thang added that;

1) The selection criteria of priority projects should look at risks, and consider the aspects of land protection, flood prevention, adaptation and coping. On the prevention of saline instruction, MARD needs to consider whether we should build the new sluice or shift to the saline friendly cropping model in taking advantages of saline intrusion. We should not build big structures to avoid the regret investment. The scheme scale proposed by JICA Team are moderate taking into account future uncertainties.

2) On the control of MR source, this is an international river, and it is uncertain in the future whether the saline level will increase or not. Therefore, we need to consider all these elements researched

by the JICA Team in order to achieve no-regret decision. In fact, the master plan Project has screened and proposed not too many structured measures, less than the Government tentative plan.

Dr. Shane Brown, GIZ, raised 2 projects; blackish aquaculture growing in Kien Giang province and water management in An Giang province, as saying that they have combined the infrastructure development project with new cropping project. Closely worked with MARD/MONRE to link the provincial priority projects with the national ones; in Kien Giang growing shrimp cultivation with mangrove; in An Giang: building dam in the upper part and rice plantation system in the lower part, water management; in Soc Trang & Bac Lieu: the balancing of freshwater and saline water utilization.

Ms. Katherine, AusAID, said that AusAID has cooperated with GIZ and has a partnership with ADB in the development of projects in the Mekong delta region. They also established coordination of all the nations in the Mekong river region. AusAID has been working in the Mekong delta region since 2008, and they try to coordinate with other donors and the government to avoid the overlapping of projects in the region. They are preparing a mapping of intervention projects. Coordination is now due required among the Australian Agricultural Research Institute and French Development Agency in developing a drought resistant rice variety.

Mr. Nguyen Cong Chuc, GIZ/AUSAID Project, highly appreciated the study with details. He agreed with the 4 proposals from the Project, and in deed same as the understanding of VM Thang on the issues particularly issue No.1 and No.2 on the priority. He further solicited attention on the report of UN Climate Change Committee wherein it might be overstated, whereby MARD should carefully consider this when developing projects. Vietnam is still a poor country, and therefore we should consider very carefully how to spend investment, not wasting sources.

Mr. Nguyen Cong Chuc further raised concerns in the presentation such that; 1) temperature increase shall reduce the production yield, but practically reports show that the recent production yield has increased, so there is difference between the theory and the fact on the ground, 2) rainfall may increase in future however there are some droughts, 3) there would be flooding according to the simulation while according to WB there is no flood in Mekong delta, 4) saline intrusion will increase in future while there may be increase of Mekong River discharge in future, and 5) we may be looking more for the non-structural measures.

Mr. Hien, Director of SIWRP, thanked the participants for their comments to the report. He encouraged all the concerned agencies to continue send their feedback/comments to the Project office in SIWRP. Then, the Vice Minister Mr. Thang concluded the workshop with the following remarks:

The presentation is profound, flexible with the uncertain factors, whereby leading to no regret investment. MARD highly appreciates the non-structured measures, education on awareness raising, etc. The crop production yield increases thanks to the new variety, new production process. However the temperature increase and other factors may result in the production loss. In practice, although the rainfall increases, the climate becomes more extreme resulting in more severe drought and/or flooding. In addition to the nature factors, there are human factors, e.g. hydro-power reservoirs establishment in the upstream countries. Finally the Excellency stressed that this Project started since Quarter 3 of 2011, and has achieved very good results. It helps clear out some ideas and also the well structured methodologies. MARD is in fact to take such role in coordination and linkage of activities. MARD really appreciates for the international support as demonstrated by JICA, and other donors such as GIZ, AusAID.

Participants to the Draft Report Presentation Meeting at Can Tho (January 28)

Ministry of Agriculture and Rural Development

1.	Mr. Hoang Van Thang	Vice Minister, MARD
2.	Mr. Le Hoang Tung	Department Agriculture and Rural Development in Bac Lieu
3.	Mr. Le Ngoc Lan	Department Agriculture and Rural Development in Bac Lieu
4.	Mr. Huynh Kim Muoi	Vice Director- Department Agriculture and Rural Development in Ben Tre
5.	Mr. Pham Van Quynh	Director-Department Agriculture and Rural Development in Can Tho
6.	Mr.Le Cong Thanh	Department Agriculture and Rural Development in Can Tho
7.	Mr.Nguyen Thanh Binh	Can Tho University
8.	Mr.Dinh Diep Anh Tuan	Can Tho University
9.	Mr.Nguyen Hieu Trung	Can Tho University
10.	Mr.Do Van Nhan	Director of Center Project Office No.10
11.	Mr.Lieu Nghia Phuong	Department Agriculture and Rural Development in Can Tho
12.	Mr. Dang Ngoc Loi	Department Agriculture and Rural Development in Dong Thap
13.	Mr. Chau Van Duong	Department Agriculture and Rural Development in Dong Thap
14.	Mr.Tran Chi Hung	Vice Director- Department Agriculture and Rural Development in Hau Giang
15.	Mr.Le Phuoc Dai	Head of Water Resource Section -Department Agriculture and Rural Development in Hau Giang
16.	Mr.Do Minh Nhut	Department Agriculture and Rural Development in Kien Giang
17.	Mr.Cao Van Nam	Department Agriculture and Rural Development in Kien Giang
18.	Mr.Nguyen Phu Huu	Department Agriculture and Rural Development in Long An
19.	Mr.Ung Hong Nghi	Department Agriculture and Rural Development in Tien Giang
20.	Mr.Pham Thanh Tam	Department Agriculture and Rural Development in Tien Giang
21.	Mr.Tran Hoang Ba	Department Agriculture and Rural Development in Tien Giang
22.	Mr.Nguyen Van Truong	Department Agriculture and Rural Development in Tra Vinh
23.	Mr. Do Vu Hung	Department Agriculture and Rural Development in An Giang
24.	Mr. Nguyen Van Hung	Department Agriculture and Rural Development in An Giang
25.	Mr. Huynh Tan Loi	Department Agriculture and Rural Development in Vinh Long
26.	Mr.Nguyen Van Nhan	Department Agriculture and Rural Development in Vinh Long (Head of Water Resources Section)
27.	Dr.Vu Dinh Hung	Central Project Office
28.	Mr.Du Dinh Tao	Central Project Office
29.	Mr. Dang The Minh	Central Project Office
30.	Mr.Tran Quang Hoai	Central Project Office
31.	Mr. Nguyen Hong Phuong	Central Project Office
32.	Mr.Tran Duy Tien	Central Project Office
33.	Mr. Tran Minh Nhat	Directorate of Water Resources
34.	Ms.Nguyen Thi Thu Ha	Department of Water Resources Construction Management
35.	Mr.Vuong Viet Hung	Directorate of Water Resources
36.	Mr.Hoang Anh Tuan	Directorate of Water Resources
37.	Mr.Doan The Loi	IWEM
38.	Ms.Dang Thi Hue	Department of Planning
39.	Mr.Dang Duc Cuong	Department of Plant Protection
40.	Mr. Ngo Quang Thanh	Center of Agriculture and Rural Strategy

11

41.	Mr.Ho Van Chien	Southern Department of Plant Protection (Director)
42.	Mr. Le Xuan Bao	Water Resources University-2nd Base
43.	Mr.Nguyen Van Trong	Research Institute for Aquaculture No.2
44.	Mr.Luu Hong Man	Cuu Long Delta Rice Research Institute (Vice Director)
45.	Mr.Nguyen Duc Ngan	Southern Sub-Institute of Forest Inventory and Planning
46.	Mr. Le Thanh Tung	Department of Cultivation Plant
47.	Mr.Nguyen Van Hoa	SOFRI
48.	Mr.To Quang Toan	SIWRR
49.	Mr. To Van Thanh	SIWRR
50.	Mr.Nguyen Trong Uyen	Sub-NIAPP
51.	Ms.Dang Thi Hue	Department of Cultivation Plant
52.	Mr.Hoang Van Huan	Institute of Coastal and Offshore Engineering
53.	Mr.Dinh Quang Vu Binh	Institute of Coastal and Offshore Engineering

People's Committee

54.	Mr.Dao Anh Dung	Vice Chairman Can Tho city
55.	Mr. Le Thanh Dung	Vice Chairman -Provincial People Committee in Bac Lieu
56.	Mr.Tran Anh Tuan	Vice Chairman -Provincial People Committee in Ben Tre
57.	Mr. Nguyen Thanh Nhon	Vice Chairman-Provincial People Committee in Hau Giang
58.	Mr. Nguyen Van Thai	Provincial People Committee in Ben Tre
59.	Ms. Le Dinh Van Khanh	Provincial People Committee in Can Tho
60.	Mr.Nguyen Thi Huynh Hoa	Provincial People Committee in Hau Giang
61.	Mr. Tran Hoang Nhat Nam	Provincial People Committee in Tien Giang
62.	Mr. Ha Ngoc Hien	Provincial People Committee in Vinh Long

Southern Institute of Water Resources Planning

63.	Mr. Nguyen Xuan Hien	Director, SIWRP
64.	Mr. Dang Thanh Lam	Head of Hydrology Division
65.	Mr. Bui Ngoc	Cuu Long Delta division
66.	Ms. Nguyen Thu Ha	Technical and International Cooperation Division
67.	Mr. Le Viet Minh	Mekong Delta Planning Division
68.	Ms. Dang Thi Thuy Hang	Climate Change and Disaster Responses Centre

JICA Vietnam Office

69.	Mr. Yukio Ishida	Representative, JICA HCM Office
70.	Ms. Phan Thi Thanh Truc	Project Official, JICA HCM Office

JICA Study Team

71.	Mr. Kosei Hashiguchi	Team Leader / Rural Development Planning
72.	Dr. Motoyohsi Hikasa	Co-leader / Irrigation & Drainage / Rural Infrastructure

Journalist

73.	Mr. Trung Chanh	Sai Gon Economic Times
74.	Nguyen Thanh Hoang	Communist Party newspapers
75.	Mr.Truong CA	Foreign Investment newspapers
76.	Mr.Nguyen Thanh Hai	Rural Economic newspapers
77.	Mr.Huynh Van Xay	Newspaper people's Army
78.	Mr.Duong Duy Lai	TV Can Tho city

79.	Mr. Thanh Sang	News Agency
80.	Mr.Ca Linh	Newspaper Workers
81.	Mr.Huynh Van Khoi	Investment Newspapers
82.	Ms.Phuong Thao	VTV
83.	Mr.Nguyen Hong Phu	VTV
84.	Mr.Nguyen Tri Phong	Newspapers Sai Gon Liberation
85.	Mr.Pham The Dat	News Agency
86.	Ms.Hong Cam	Today Rural Newspapers
87.	Ms.Minh Huyen	Can Tho Newspapers
88.	Ms.Phan Thi Lan Chi	Developing National Newspaper
89.	Mr. Nguyen Hai	Voice of Vietnam
90.	Mr.Pham Chi Quoc	Youth Newspaper
91.	Mr.Le Van Hung	Environment Resources Newspaper

II. Participants to the Draft Report Presentation Meeting at Hanoi (January 30)

Ministry of Agriculture and Rural Development

1.	Mr. Hoang Van Thang	Vice Minister, MARD
2.	Mr. Do Van Nam	Department of Technical and International Cooperation (Directorate of Fisheries and Aquaculture)
3.	Mr. Luong Ngoc Chung	Institute for Water Resources Planning
4.	Mr. Pham Trung Mai	Department of Legal and Inspector (Directorate of Water Resources)
5.	Mr. Nguyen Viet	Department of Financial Planning (Directorate of Water Resources)
6.	Mr. Nguyen Ton Quan	Expert, Department of Dyke and Flood Prevention (Directorate of Water Resources)
7.	Mr.Le Van Duong	Department of Basic Construction (Directorate of Water Resources)
8.	Mr.Ngo Hao Hiep	Department of Construction Management (Directorate of Water Resources)
9.	Mr. Nguyen Duc Quang	Consultancy Centers and Irrigation Technology Transfer
10.	Ms. Doan Thi Tuyet Nga	Department of Science Technology and International Cooperation
11.	Ms. Do Thi Phuong Thao	Department of Science Technology and International Cooperation

Ministry of Natural Resources and Environment

12.	Mr. Nguyen Trong Hung	Technical Coordinator, PUC, SP-RCC, MONRE

Donors

13.	Dr. Sharon Brown	GIZ Kien Giang
14.	Mr. Nguyen Cong Chuc	GIZ Vietnam
15.	Mr. Chu Van Cuong	GIZ Kien Giang
16.	Mr. Nguyen Quoc Viet	AusAID
17.	Ms. Kathryn Elliott	AusAID
18.	Mr. Ian Wood	USAID

Southern Institute of Water Resources Planning

19.	Mr. Nguyen Xuan Hien	Director, SIWRP

20.	Mr. Ho Trong Tien	Director, Centre of Climate Change and Natural Disaster Responses-SIWRP
21.	Mr. Pham Anh Tuan	Head of Planning division
22.	Ms. Nguyen Thu Ha	Technical and International Cooperation Division

JICA Vietnam Office

23.	Ms. Ui Nozomi	Representative, JICA Vietnam Office
24.	Ms. Nguyen Thi Thu Le	Project Official, JICA Vietnam Office
25.	Mr. Sugatani Susumu	JICA advisor to MARD
26.	Mr. Naoki Mori	JICA adviser to MONRE, in charge of CC

JICA Study Team

27.	Mr. Kosei Hashiguchi	Team Leader / Rural Development Planning
28.	Dr. Motoyohsi Hikasa	Co-leader / Irrigation & Drainage / Rural Infrastructure

Journalist

29.	Mr. Bui Thanh Tung	Audit journalist
30.	Mr.Tran Trung Kien	TV-VTC
31.	Mr.Thanh Trong	News Agency
32.	Mr.Nguyen Minh Hue	Rural Economic Newspapers

APPENDIX-II

WATER RESOURCES

APPENDIX II: WATER RESOURCES

TABLE OF CONTENTS

II.1 Proposed Projects from 2011 – 2015 by SIWRP MP (2011) II-1-1
II.2 Proposed Projects from 2016 – 2020 by SIWRP MP (2011) II-2-1
II.3 Proposed Projects from 2011 – 2015 by SIWRP MP (2011) II-3-1
II.4 Proposed Projects after 2030 by SIWRP MP (2011) II-4-1

LIST OF FIGURES:

Figure 1.1 Proposed Projects from 2011 – 2015 by SIWRP MP (2011) II-1-4
Figure 2.1 Proposed Projects from 2016 – 2020 by SIWRP MP (2011) II-2-5
Figure 3.1 Proposed Projects from 2011 – 2015 by SIWRP MP (2011) II-3-4
Figure 4.1 Proposed Projects after 2030 by SIWRP MP (2011) II-4-2

II.1. Proposed Projects from 2011 – 2015 by SIWRP MP (2011)

No.	Hydraulic Works	Location	Function
I	**LONG XUYEN QUADRANGLE**		
1.1	*Flood control system along the Vietnam - Cambodia border*		
1	Dam Chich Sluice	KG I.1	Flood control, water supply
1.2	*Sluice system for saline control along West Sea*		
1	Ta Xang Sluice	KG I.2	Saline control, flood control
2	Tam Ban Sluice	KG I.3	Saline control, flood control
3	Ta Lua Sluice	KG I.4	Saline control, flood control
4	Bridge No 1 Sluice	KG I.5	Saline control, flood control
5	Rach Gia Sluice	KG I.6	Saline control, flood control
II	**CA MAU PENINSULA**		
2.1	*Hydraulic works Cai Lon - Cai Be*		
1	Cai Lon Sluice	KG I.7	Saline control and irrigation
2	Cai Be Sluice	KG I.8	Saline control and irrigation
3	Xeo Ro Sluice and Ship Lock	KG I.9	Saline control
4	Thot Not Canal	KG I.10	Water supply and irrigation
5	KH6 Canal	KG I.11	Water supply and irrigation
6	KH7 Canal	KG I.12	Water supply and irrigation
2.2	*Hydraulic works along West Sea*		
1	Embankment in Khanh Hoi Estuary	KG	Against erosion
2	Embankment in Da Bac Estuary	KG I.13	Against erosion
3	Sluice of No 13 Canal in U Minh Thuong ring dikes	KG I.14	Against forest fire
4	Sluice of No 12 Canal in U Minh Ha ring dikes	KG I.15	Against forest fire
2.3	*Hydraulic works for saline control in the field of CMP*		
1	Hydraulic works for sub-region 17, South of CMP	CM I.1	Saline control, drainage and water storage
2	Hydraulic works for sub-region 5, South of CMP	CM I.2	Saline control, drainage and water storage
3	Hydraulic works for sub-region 2, South of CMP	CM I.3	Saline control, drainage and water storage
4	Hydraulic works for sub-region 3, North of CMP	CM I.4	Saline control, drainage and water storage
5	Embankment to protect Nam Can Town	CM I.5	Against erosion
6	Embankment to protect Tan Tien Market	CM I.6	Against erosion
7	Embankment at CM Cape	CM I.7	Against erosion
8	Primary canal systems in the South of CMP	CM I.8	Saline control, drainage and water storage
9	Primary canal systems in U Minh Ha	CM I.9	Saline control, drainage and water storage
10	Hydraulic works for sub-region 12, South of CMP	CM I.10	Saline control, drainage and water storage

No.	Hydraulic Works	Location	Function
11	Hydraulic works O Mon - Xa No (Stage 2)	KG I.16	Flooding drainage and alum washing
12	Xeo Can Canal	KG I.17	Flood water drainage and irrigation
2.4	*Sluices along Ganh Hao River*		
1	Lung Danh Sluice	CM I.11	Saline control and drainage
2	Rach Rong Sluice	CM I.12	Saline control and drainage
3	Rach Trai Sluice	CM I.13	Saline control and drainage
2.5	*Hydraulic works along East Sea*		
1	Ganh Hao Embankment	BL I.1	Against erosion
2.6	*Hydraulic works in Quan Lo - Phung Hiep*		
1	Hydraulic works as demarcating line for separating salt water and fresh water in Quan Lo – Phung Hiep	BL I.2	Saline control and drainage
11	Hydraulic works in 4 districts in low-lying region of Soc Trang province	ST I.1	Constructing new rural area
12	Dredging Xa No 2 Canal	KG I.18	Water drainage and supply
2.7	*Hydraulic works for aquaculture*		
1	Hydraulic works for aquaculture in Tan Duyet (Dam Doi)	CM I.14	Water drainage and supply
2	Upgrading hydraulic works for aquaculture in sub-region 3, South of CMP	CM I.15	Water drainage and supply
2.8	*Hydraulic works Tac Van - Cai Keo*	*BL I.3*	*Saline control*
2.9	*Hydraulic works Long Dien - Long Hai*	*BL I.4*	*Saline control*
3	*Upgrading hydraulic works for aquaculture in Dien Dong, Dien Tay*	*BL I.5*	*Water drainage and supply*
III	**BETWEEN MEKONG RIVER AND BASSAC RIVER**		
3.3	*Hydraulic works in the South of Mang Thit River*		
1	Secondary canal systems in the South Mang Thit River	TV I.1	Water drainage and supply
2	Long Binh Embankment in Co Chien River (Stage 2)	TV I.2	Bank protection
3	Embankment along the coastal in Hiep Thanh (Stage 2)	TV I.3	Bank protection
4	Embankment along the coastal in Con Trung, Truong Long Hoa	TV I.4	Bank protection
5	Tan Dinh Sluice	TV I.5	Saline control and drainage
6	Bong Bot Sluice	TV I.6	Saline control and drainage
7	Upgrading Trem Sluice	TV I.7	Saline control and drainage
8	Embankment in Long Hoa - Hoa Minh Isle	TV I.8	Saline control
9	Embankment in the South of Tra Cu Canal	TV I.9	Saline control
10	Embankment of Vam Lau - Bac Trang River	TV I.10	Saline control
3.4	*Hydraulic works in the North of BT Province (Stage 1)*	*BT*	*Saline control and irrigation*
3.5	*Hydraulic works between Mekong River and Bassac River*		

No.	Hydraulic Works	Location	Function
1	Hydraulic works in Cai Quao	BT I.1	Saline control and irrigation
2	Embankment of BT River	BT I.2	Against erosion
3	Hydraulic works of Cho Lach - Thanh Phu Canal	BT I.3	Saline control and irrigation
3.6	*Hydraulic works for aquaculture*		
1	Hydraulic works for aquaculture in Tam Vu Lo (Cau Ngang)	TV I.11	Water supply and drainage
2	Hydraulic works for aquaculture in Dong Don	TV I.12	Water supply and drainage
3	Hydraulic works for catfish	VL I.1	Water supply and drainage
IV	**LEFT SIDE OF MEKONG RIVER**		
4.3	*Hydraulic works in the left-hand side of Mekong River*		
23	Hydraulic works to protect Muoi Tan orchards	TG I.1	Flood control
24	Canal 7	TG I.2	Flood water drainage and irrigation
25	Canal 10 - Phu An	TG I.3	Flood water drainage and irrigation
26	Canal 9	TG I.4	Flood water drainage and irrigation
27	Tan Long Embankment	TG I.5	Bank protection
28	Embankment in the West of Ba Rai River	TG I.6	Bank protection
29	Cuu Trung Reservoir	TG I.7	Fresh water store
30	Hydraulic works to protect pineapple orchards	TG I.8	Flood control
31	Hydraulic works to protect orchards in Cai Be and along Mekong River	TG I.9	Flood control
	1. The East of Canal No 6	TG I.10	Flood control
	2. The West of Canal No 6	TG I.11	Flood control
32	Embankment in Sa Dec Town (Stage 2)	DT I.1	Against erosion
43	My Hoa - An Phong - Bac Dong Canal	DT – TG I.2	Flood water drainage and irrigation
4.4	*Bao Dinh Project (Stage 2)*	*TG I.12*	*Saline control and irrigation*
V	**ISLANDS**		
5.1	Upgrading Duong Dong Reservoir, Phu Quoc	KG I.19	Water supply
5.2	Suoi Lon Reservoir, Phu Quoc	KG I.20	Water supply
5.3	Hon Ngang Reservoir, Nam Du	KG I.21	Water supply
5.4	Hon Mau Reservoir, Nam Du	KG I.22	Water supply
5.5	Reservoir in Hamlet 1, Hon Tre	KG I.23	Water supply

Hydraulic works which are under construction.

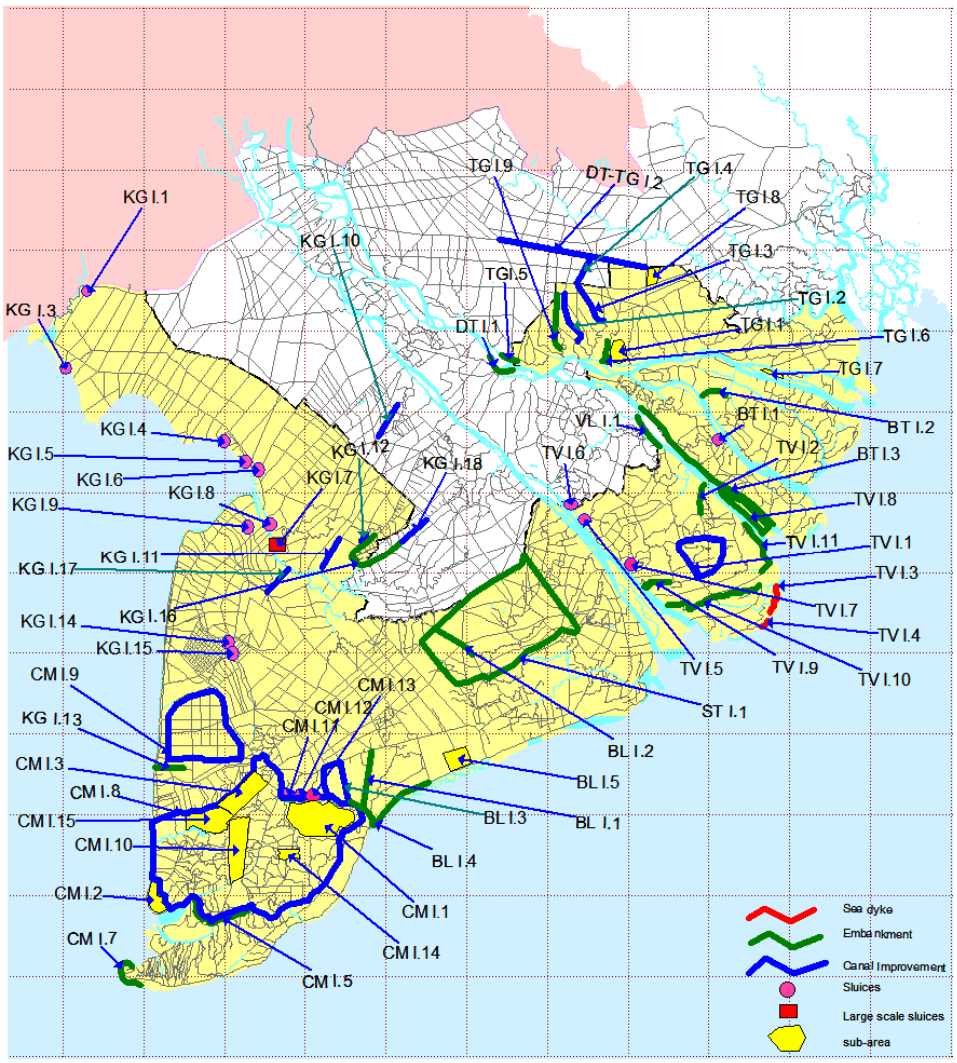


Figure 1.1 Proposed Projects from 2011 – 2015 by SIWRP MP (2011)

II.2. Proposed Projects from 2016 – 2020 by SIWRP MP (2011)

No.	Name	Location	Function
I	**LONG XUYEN QUADRANGLE**		
1.1	*System of canals flooding to West Sea*		
1	Cai San Canal	KG II.1	Flooding drainage and irrigation
2	Tron Canal	KG II.2	Flooding drainage and irrigation
3	Giua Canal - Long Xuyen Canal	KG II.3	Flooding drainage and irrigation
4	Kien Hao - Trac Nang Gu Canal	KG II.4	Flooding drainage and irrigation
5	My Thai - Muoi Chau Phu Canal	KG II.5	Flooding drainage and irrigation
9	Canal No 1	KG II.6	Flooding drainage and irrigation
10	Canal T4	KG II.7	Flooding drainage and irrigation
11	Canal T3	KG II.8	Flooding drainage and irrigation
12	Canal T2	KG II.9	Flooding drainage and irrigation
13	Nong Truong Canal	KG II.10	Flooding drainage and irrigation
1.2	*Hydraulic works in Long Xuyen Quadrangle*		
1	Embankment in Rach Gia City	KG II.11	Against erosion
II	**CA MAU PENINSULA**		
2.1	*Hydraulic works to prevent salinity in the South of Chac Bang*		
1	Cai Chanh Sluice	BL – CM II.1	Saline control and drainage
2	Canh Den - Pho Sinh Sluice	CM II.2	Saline control and drainage
3	Phong Thanh Tay Sluice	CM II.3	Saline control and drainage
4	Xang Canal - Huyen Su Sluice	CM II.4	Saline control and drainage
5	Tan Phong Sluice	CM II.5	Saline control and drainage
2.2	*Hydraulic works in Cai Lon - Cai Be region*		
1	Xeo Ro 1 Sluice	KG II.12	Water supply and saline control
2	Xeo Ro 2 Sluice	KG II.13	Water supply and saline control
3	KH1 Canal	KG II.14	Water supply and irrigation
4	Giua Canal	KG II.15	Water supply and irrigation
5	KH3 Canal	KG II.16	Water supply and irrigation
6	KH5 Canal	KG II.17	Water supply and irrigation
2.3	*Hydraulic works for saline control in the field of CMP*		
1	Hydraulic works of sub-region 14, South of CMP	CM II.7	Saline control, drainage and water storage
2	Hydraulic works of sub-region 15, South of CMP	CM II.8	Saline control, drainage, water storage
3	Hydraulic works for sub-region 4, South of CMP	CM II.9	Saline control, drainage, water storage
4	Hydraulic works for sub-region 6, South of CMP	CM II.10	Saline control, drainage, water storage
5	Hydraulic works for sub-region 7, South of CMP	CM II.11	Saline control, drainage, water storage
6	Hydraulic works for sub-region 8, South	CM II.12	Saline control, drainage, water

No.	Name	Location	Function
	of CMP		storage
7	Hydraulic works for sub-region 9, South of CMP	CM II.13	Saline control, drainage, water storage
8	Hydraulic works for sub-region 10, South of CMP	CM II.14	Saline control, drainage, water storage
9	Hydraulic works for sub-region 13, South of CMP	CM II.15	Saline control, drainage, water storage
10	Hydraulic works for sub-region 1, North of CMP	CM II.16	Saline control, drainage, water storage
11	Hydraulic works for sub-region 2, North of CMP	CM II.17	Saline control, drainage, water storage
12	Hydraulic works for sub-region 11, South of CMP	CM II.18	Saline control, drainage, water storage
13	Hydraulic works for sub-region 16, South of CMP	CM II.19	Saline control, drainage, water storage
14	Ong Doc Dyke	CM II.20	Saline control, natural disaster prevention
15	Rach Goc - Duong Keo Dyke (Eastern bank)	CM II.21	Saline control, natural disaster prevention
16	Ganh Hao Dyke	CM II.22	Saline control, natural disaster prevention
17	Rach Muong Dao Dyke	CM II.23	Saline control, natural disaster prevention
18	Bay Hap Dyke	CM II.24	Saline control, natural disaster prevention
19	Cai Doi Dyke	CM II.25	Saline control, natural disaster prevention
20	Ong Trang Dyke (Western bank)	CM II.26	Saline control, natural disaster prevention
21	Muong Cung Dyke	CM II.27	Saline control, natural disaster prevention
22	Trai Luoi Dyke (Southern bank)	CM II.28	Saline control, natural disaster prevention
23	Ben Dua Dyke (Southern bank)	CM II.29	Saline control, natural disaster prevention
24	Cai Ngay Dyke	CM II.30	Saline control, natural disaster prevention
25	Ong Don Dyke (Southern bank)	CM II.31	Saline control, natural disaster prevention
26	Muoi Bay Dyke (Nam Can)	CM II.32	Saline control, natural disaster prevention
27	Dam Chim Dyke (Eastern bank)	CM II.33	Saline control, natural disaster prevention
28	Bay Hap Dyke (Eastern bank)	CM II.34	Saline control, natural disaster prevention
29	Tan Anh - Dong Hung Dyke	CM II.35	Saline control, natural disaster prevention
30	Rau Dua - Bau Vung Dyke	CM II.36	Saline control, natural disaster prevention
35	Lo Xe - Cai Nuoc Dyke (Eastern bank)	CM II.37	Saline control, natural disaster prevention

No.	Name	Location	Function
36	KT1 Canal - An Minh	KG II.18	Flooding drainage, irrigation
2.6	*System of sluices along Bassac River*		
1	Saintard Sluice	ST II.1	Saline control, drainage
2.7	*Solidification of canal system in Phuoc Long district*	*BL II.2*	*Irrigation*
1	Rach Mop Sluice	ST II.2	Saline control, drainage
III	**BETWEEN MEKONG RIVER AND BASSAC RIVER**		
3.2	*Hydraulic works in the South of Mang Thit River*		
2	Embankment in Long Thanh – Phu An Isle (TV 1)	TV II.1	Saline control
3	Tra Ech Canal	TV II.2	Water supply and drainage
4	O Chat – Ngang Canal	TV II.3	Water supply and drainage
5	Tra Ngoa Canal	TV II.4	Water supply and drainage
6	Tan An Canal	TV II.5	Water supply and drainage
7	Thuy Loi Canal	TV II.6	Water supply and drainage
8	Thai Rai Canal	TV II.7	Water supply and drainage
9	Tan Lap Canal	TV II.8	Water supply and drainage
10	Vinh Binh – My Cam Canal	TV II.9	Water supply and drainage
11	Ngay Canal	TV II.10	Water supply and drainage
12	Nha Tho Canal	TV II.11	Water supply and drainage
13	Bang Da Canal	TV II.12	Water supply and drainage
14	Thong Nhat – Luong Hoa Canal	TV II.13	Water supply and drainage
15	Ca Nguyet Canal	TV II.14	Water supply and drainage
16	Song Loc Canal	TV II.15	Water supply and drainage
17	Ba Tram B Canal	TV II.16	Water supply and drainage
18	Dai An Canal	TV II.17	Water supply and drainage
19	Vam Buon Canal	TV II.18	Water supply and drainage
20	Bac Trang Canal	TV II.19	Water supply and drainage
21	Te Te Canal	TV II.20	Water supply and drainage
22	Tra Mem Canal	TV II.21	Water supply and drainage
23	Trem Canal	TV II.22	Water supply and drainage
24	Cau Tre Canal	TV II.23	Water supply and drainage
25	Chanh Sam Canal	TV II.24	Water supply and drainage
26	Chinh Phu Canal	TV II.25	Water supply and drainage
27	Vam Lau – Bac Trang Embankment		
	- 25 bridges belong to Vam Lau – Bac Trang Embankment	TV II.27	Rural roads
IV	**LEFT-HAND SIDE OF MEKONG RIVER**		
4.2	*System of canals to drain flood to Mekong River*		
6	Ben Chua Canal	TG II.1	Flooding drainage, irrigation
7	Sau Au Canal	TG II.2	Flooding drainage, irrigation
8	Nguyen Tan Thanh Canal	TG II.3	Flooding drainage, irrigation
9	Cau Sao Canal	TG II.4	Flooding drainage, irrigation
10	Mu U Canal	TG II.5	Flooding drainage, irrigation

No.	Name	Location	Function
11	Thanh Nien Canal	TG II.6	Flooding drainage, irrigation
12	Ba Rai Canal	TG II.7	Flooding drainage, irrigation
13	Song Lu – Bang Day Canal	TG II.8	Flooding drainage, irrigation
14	Canal No 9	TG II.9	Flooding drainage, irrigation
15	Canal No 8	TG II.10	Flooding drainage, irrigation
16	Canal No 6 (Bang Lang)	TG II.11	Flooding drainage, irrigation
17	Canal No 5	TG II.12	Flooding drainage, irrigation
18	Rach Ruong Canal	TG II.13	Flooding drainage, irrigation
4.3	*System of canals to flood and irrigate in Mekong River and Vaico River*		
1	Thap Muoi – Nguyen Van Tiep – Tong Doc Loc Canal	TG II.14	Flooding drainage, irrigation
4.4	*Hydraulic works Bao Dinh – Go Cong*		
1	Go Cong I Sea Dyke	TG II.15	Saline control
2	Go Cong II Sea Dyke (Phu Loi Isle)	TG II.16	Saline control
V	**ISLANDS**		
1	Rach Ca Reservoir, Phu Quoc	KG II.19	Water supply for living

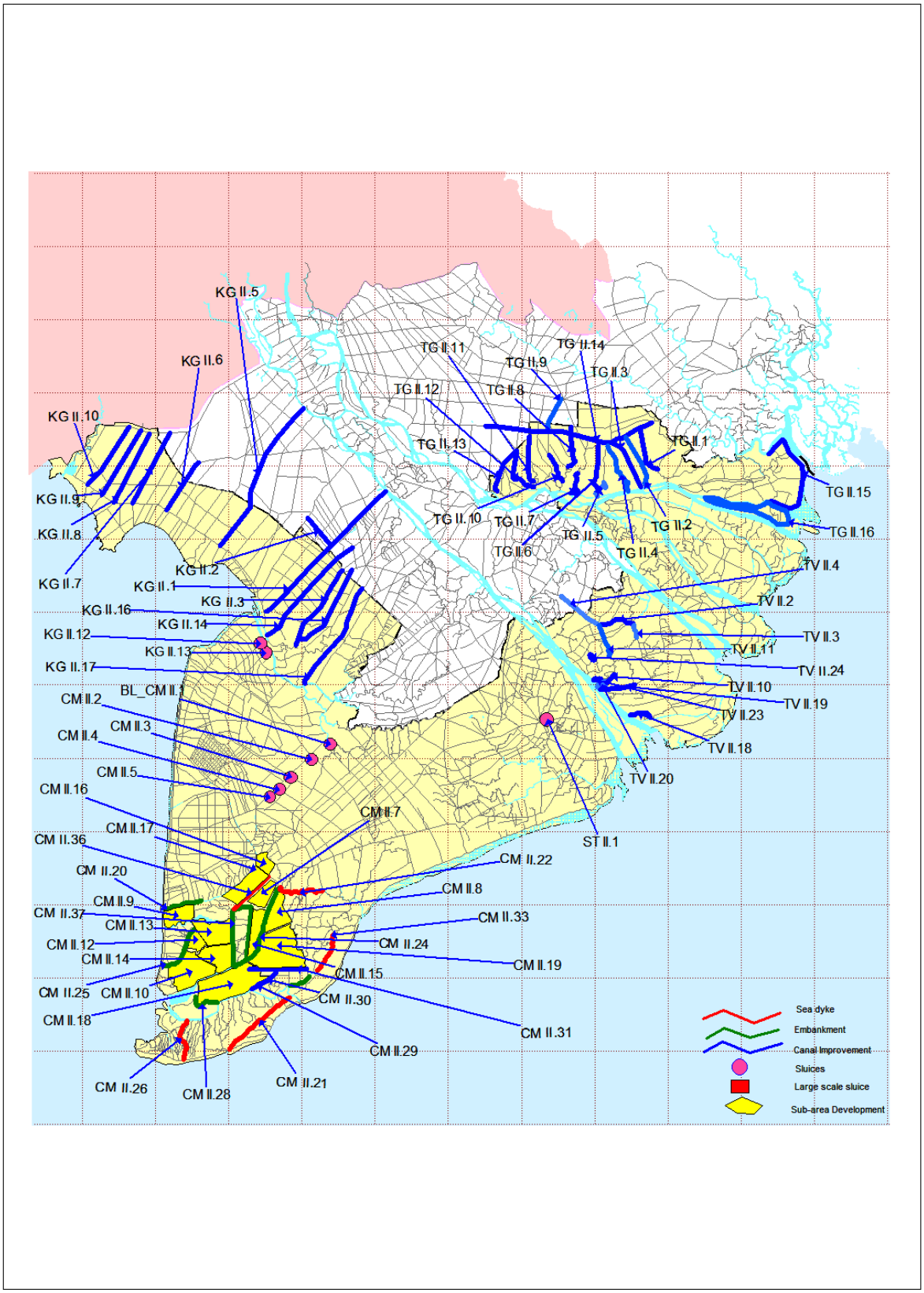


Figure 2.1 Proposed Projects from 2016 – 2020 by SIWRP MP (2011)

II.3. Proposed Projects from 2021 – 2030 by SIWRP MP (2011)

No.	Name	Location	Function
I	**LONG XUYEN QUADRANGLE**		
1.1	*Hydraulic works to control flood along the border*		
1	Complete Tinh Bien – Ha Giang dykes	KG III.1	Flood control, water supply
1.2	*Sluice system to control salinity along West Sea*		
1	Upgrading dykes II, III (Cai San – An Binh)	KG III.2	Saline and flood control
1.3	*Hydraulic works in Long Xuyen Quadrangle*		
1	Dredging second-level canals in Ha Tien Quadrangle	KG III.3	Irrigation
II	**CA MAU PENINSULA**		
2.1	*Hydraulic works along West Sea*		
1	Sea dykes KG I (Can Gao -Tieu Dua)		
	1. Sea dykes KG I	KG III.4	Saline control, natural disaster prevention
	2. 15 sluices along the sea dykes	KG III.5	Saline control, drainage
2	Sea dykes CM III (Tieu Dua – Ong Doc)	CM III.1	
	1. Sea dykes CM III	CM III.2	Saline control, natural disaster prevention
	2. 6 sluices along the sea dykes	CM III.3	Saline control, drainage
3	Sea dykes CM II (Ong Doc – Bay Hap)	CM III.4	
	1. Sea dykes CM III	CM III.5	Saline control, natural disaster prevention
	2. 10 sluices along the sea dykes	CM III.6	Saline control, drainage
2.2	*System of tertiary-level hydraulic works to control salinity in CMP*		
1	Lung Tram Sluice	CM III.7	Saline control, drainage
2	Mui Tram Sluice	CM III.8	Saline control, drainage
3	Cai Nuoc – Cha La Embankment	CM III.9	Saline control, natural disaster prevention
4	Embankment along Dam Thi Tuong	CM III.10	Saline control, natural disaster prevention
5	Thi Keo – Tho Mai – Bao Trau Embankment	CM III.11	Saline control, natural disaster prevention
6	Cai Doi Vam Embankment (Eastern bank)	CM III.12	Saline control, natural disaster prevention
7	Phung Hiep Embankment (Eastern bank)	CM III.13	Saline control, natural disaster prevention
8	Trem River Embankment (Western bank)	CM III.14	Saline control, natural disaster prevention
9	Lang Tram Embankment (Southern bank)	CM III.15	Saline control, natural disaster prevention
10	Bien Nhi Embankment (Eastern bank)	CM III.16	Saline control, forest fire prevention
11	Binh Minh – Tu Embankment	CM III.17	Saline control
12	Embankment of Canal 11 (Southern bank)	CM III.18	Saline control, forest fire

No.	Name	Location	Function
			prevention
13	KH8 Canal	KG III.6	Water supply, irrigation
14	KH9 Canal	KG III.7	Water supply, irrigation
2.3	*Hydraulic works along East Sea*		
1	Sea dykes CM II (Bay Hap – Ganh Hao)		
	1. Sea dykes CM II	CM III.19	Saline and sea level rise control
	2. 10 sluices along the sea dykes	CM III.20	Saline control, drainage
2	Upgrading dykes in BL	BL III.1	Saline and sea level rise control
3	Embankment in Cu Lao Dung		
	- Dykes	ST III.1	Saline and sea level rise control
4	Long Phu Sea Dykes	ST III.2	Saline and sea level rise control
5	Vinh Chau Sea Dykes	ST III.3	Saline and sea level rise control
6	My Thanh Dykes	ST III.4	Saline and sea level rise control
2.4	*Hydraulic works to add water in CMP*		
1	CT – Phung Hiep – ST Canal	ST III.5	Fresh-water supply, drainage
2	ST – BL Canal	ST III.6	Fresh-water supply, drainage
2.5	*System of sluices along Bassac River*		
1	My Hoi Sluice	ST III.7	Saline control, drainage
2	Rach Vop Sluice	ST III.8	Saline control, drainage
3	Cai Tram Sluice	ST III.9	Saline control, drainage
III	**BETWEEN MEKONG RIVER AND BASSAC RIVER**		
3.1	*Hydraulic works in the South of Mang Thit River*		
	a. Main hydraulic works		
3	Rum Soc Sluice	TV III.1	Saline control, drainage
	b. Local hydraulic works		
5	Muong Dao Sluice	TV III.2	Saline control, drainage
6	Quan Chanh Bo Sluice	TV III.3	Saline control, drainage
3.2	*Hydraulic works in Huong My*		
1	Canal supplying water in Huong My	BT III.1	Fresh-water supply, drainage
2	Tan Thuan Sluice	BT III.2	Saline control, drainage
3	Phu Dong Sluice	BT III.3	Saline control, drainage
4	Tan Phu Dong Sluice	BT III.4	Saline control, drainage
5	Vinh Dien Sluice	BT III.5	Saline control, drainage
6	Embankment to control salinity along Co Chien River	BT III.6	Saline and sea level rise control
7	Embankment to control salinity along Ham Luong River	BT III.7	Saline and sea level rise control
8	Thanh Phu Sea Dykes	BT III.8	Saline and sea level rise control
3.3	*Hydraulic works in North BT*		
	a. Main hydraulic works		
	a1. Mekong River		
1	Cai Cau Sluice	BT III.9	Saline control, drainage
2	Tan Dinh Sluice	BT III.10	Saline control, drainage
3	Ca Nho Sluice	BT III.11	Saline control, drainage

No.	Name	Location	Function
4	Dinh Trung Sluice	BT III.12	Saline control, drainage
	a2. Ham Luong River		
5	Ham Luong Sluice	BT III.13	Saline and sea level rise control, water storage
6	Vu Nang Sluice	BT III.14	Saline control, drainage
7	Cai Bong Sluice	BT III.15	Saline control, drainage
8	Muong Dao Sluice	BT III.16	Saline control, drainage
	b. Other hydraulic works		
9	Dykes in Mekong River		
	- Dykes	BT III.17	Saline and sea level rise control
	- 11 sluices	BT III.18	Saline control, drainage
10	Dykes in Ham Luong River		
	- Dykes	BT III.19	Saline, sea level rise control
	- 24 sluices	BT III.20	Saline control, drainage
11	Canal supplying water to Giong Trom	BT III.21	Fresh-water supply, drainage
12	Canal supplying water to Ba Lai River	BT III.22	Fresh-water supply, drainage
IV	**LEFT SIDE OF MEKONG RIVER**		
4.1	*Hydraulic works Bao Dinh - Go Cong*		
1	Canal supplying water in Binh Phan – Go Cong	TG III.1	Fresh-water supply, drainage
2	Embankment to control salinity from Mekong River and Cuu Tieu River	TG III.2	Saline, sea level rise control
3	Embankment to control salinity of Vaico River	TG III.3	Saline, sea level rise control

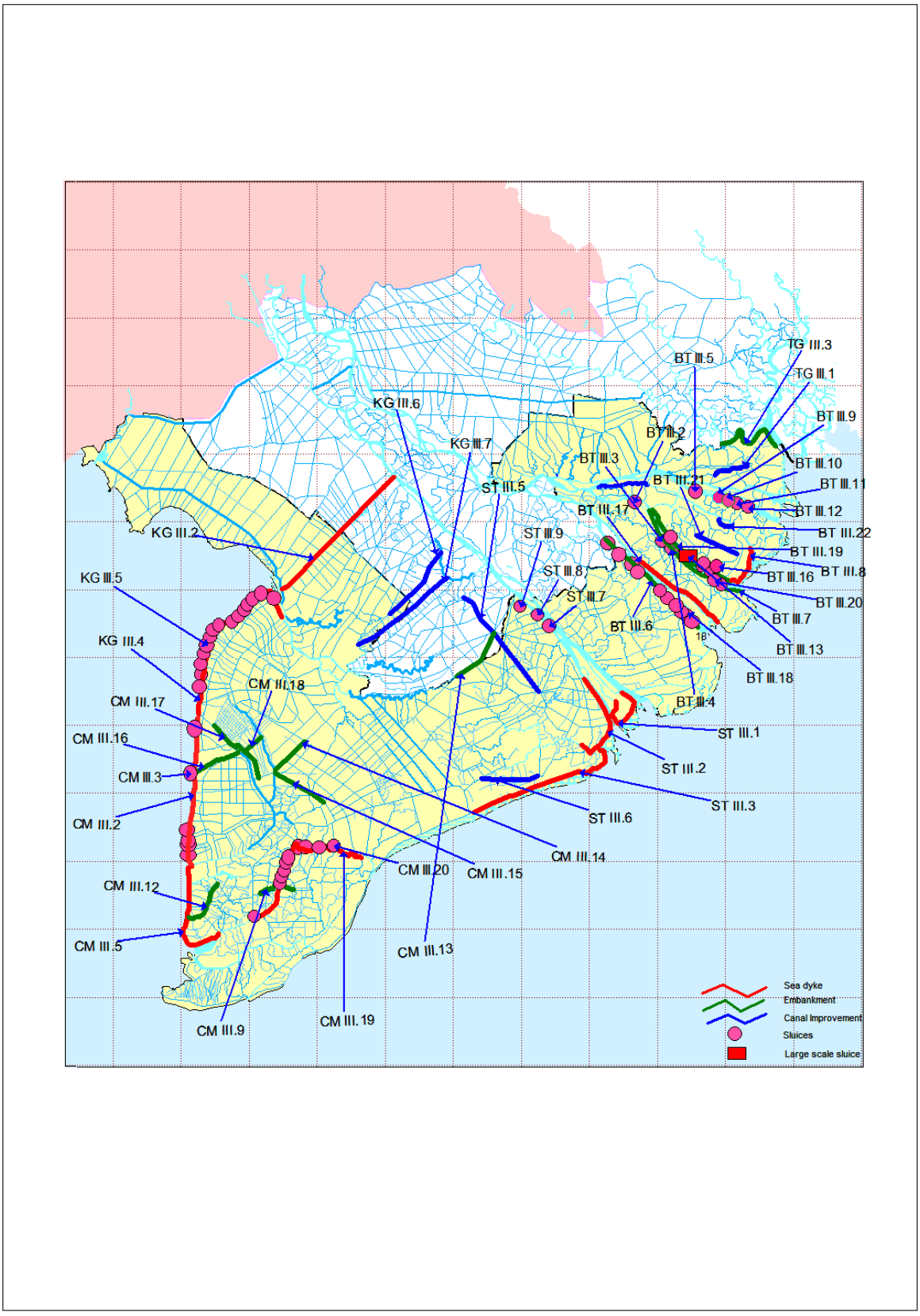


Figure 3.1 Proposed Projects from 2021 – 2030 by SIWRP MP (2011)

II.4. Proposed Projects after 2030 by SIWRP MP (2011)

No.	Name	Location	Function
II	**CA MAU PENINSULA**		
2.1	*System of sluices along Bassac River*		
1	Cai Cau Sluice	ST IV.1	Saline control, drainage
2	Cai Con Sluice	ST IV.2	Saline control, drainage
3	Dykes to control salinity along Bassac River (from Phu Thanh to sea)	ST IV.3	Saline control, natural disaster prevention
III	**BETWEEN MEKONG RIVER AND BASSAC RIVER**		
3.1	*Hydraulic works in the South Mang Thit River*		
	a. Main hydraulic works		
1	Canal supplying water to Long Ho - Vung Liem - Thong Nhat - 3/2	TV IV.1	Supplying fresh water and drainage
2	Canal supplying water to Xa Tau - Tra Ngoa - La Ban	TV IV.2	Supplying fresh water and drainage
4	Co Chien Sluice	TV IV.3	Saline control, water storage, drainage
5	Cung Hau Sluice	TV IV.4	Saline control, water storage, drainage
	b. Local hydraulic works		
6	Ring dykes to control salinity, prevent flood/tide along Bassac River	TV IV.5	Saline control
7	Ring dykes to control salinity, prevent flood/tide along Co Chien River	TV IV.6	Saline control
3.2	*System of hydaulic works in Huong My*		
1	Go Coc Sluice	BT IV.1	Saline control, drainage
2	Lam Dong Sluice (Giong Keo Canal)	BT IV.2	Saline control, drainage
3	Tan Phu Sluice (Giong Keo Canal)	BT IV.3	Saline control, drainage
4	Phuoc Khanh Sluice	BT IV.4	Saline control, drainage

Figure 4.1 Proposed Projects after 2030 by SIWRP MP (2011)

APPENDIX-III

AGRICULTURE AND LAND USE

APPENDIX III: AGRICULTURE AND LAND USE

TABLE OF CONTENTS

CHAPTER 1 SALIENT FEATURE OF AGRICULTURE SECTOR III-1-1

1.1 Agro-Ecological Zones III-1-1
1.2 Agricultural Land Use III-1-2
1.3 Crop Production and Aquaculture Production of the Country III-1-5
1.4 Perennial Crops III-1-8

CHAPTER 2 AGRICULTURE AND AQUACULTURE IN THE PROJECT AREA III-2-1

2.1 Farming Systems in The Mekong Delta III-2-1
2.2 Agriculture in the Project Area III-2-1
2.2.1 Salient Features in Agriculture III-2-1
2.2.2 Agriculture Land Use III-2-3
2.2.3 Agriculture Production in Mekong Delta III-2-7

CHAPTER 3 AGRICULTURE AND AQUACULTURE HOUSEHOLD SURVEY III-3-1

3.1 Outline of the Survey III-3-1
3.2 Family Structure of he Sample Households III-3-4
3.3 Water Sources for Agriculture and Aquaculture III-3-5
3.4 Size of Farm Plot III-3-9
3.5 Paddy Production III-3-11
3.6 Fruits Production III-3-24
3.7 Livestock Production III-3-27
3.8 Net Income of Major Cropping Patterns per Model Household III-3-29
3.9 Learning Opportunities for Agricultural Technologies III-3-32
3.10 Occurrence of Periodical Flood and Saline Intrusion III-3-33
3.11 People's Reality on Climate Change III-3-34

CHAPTER 4 LAND USE PLANNING III-4-1

4.1 Introduction III-4-1
4.2 Characteristics of Main Commodities Prevailing in the Area III-4-1
4.2.1 Profitability of Major Commodities III-4-1
4.2.2 Economic Stability of Major Commodities III-4-2
4.2.3 Suitability of Major Commodities III-4-3
4.3 Issues and Constraints Considered III-4-5
4.4 Land Use Planning and Mapping III-4-7
4.4.1 Principles and Procedure III-4-7
4.4.2 Projected Land Use Maps of Target Years upon Saline Intrusion III-4-11
4.4.3 Saline-Prone Area for Paddy Cultivation III-4-26
4.4.4 Land Use Plan Concluded for the Target Year 2050 ..... III-4-31

ATTACHMENTS

Attachment III-A: Questionnaire Survey Form (Household Survey)

Attachment III-B: Questionnaire Survey Form (Fruits Production Survey)

LIST OF TABLES

Table 1.2.1 Total Land Use Of Vietnam (2009) III-1-3
Table 1.2.2 Total Land Use of Vietnam (1961-2009) III-1-4
Table 1.3.1 Planted Area of Annual Crops and Perennial Crops III-1-5
Table 1.3.2 Planted Area of Main Annual Crops III-1-6
Table 1.3.3 Production of Main Annual Crops III-1-6
Table 1.3.4 Yield of Main Annual Crops III-1-6
Table 1.3.5 Cereal Production in 2010 ..... III-1-7
Table 1.4.1 Harvested Area of Major Perennial Crops (1961-2008) III-1-8
Table 1.4.2 Production of Major Perennial Crops (1961-2008) III-1-9
Table 1.4.3 Production of Major Perennial Crops (1961-2008) III-1-9
Table 2.2.1 Agricultural Land Use in the Project Area III-2-5
Table 2.2.2 Major Cropping Calendar in Mekong Delta III-2-6
Table 2.2.3 Production of Cereals by Province III-2-7
Table 2.2.4 Production of Cereals per Capita by Province III-2-8
Table 2.2.5 Yield of Paddy from 2000 to 2010 ..... III-2-9
Table 3.1.1 Surveyed Area and Number of Survey Samples by District III-3-1
Table 3.2.1 Average Number of Family Member per Household III-3-4
Table 3.2.2 Frequency for the Number of Family Member by District III-3-5
Table 3.3.1 Types of Water Sources for Paddy Farmers III-3-5
Table 3.3.2 Types of Water Sources for Shrimp Farmers III-3-6
Table 3.3.3 Types of Water Sources for Paddy-Shrimp Farmers III-3-6
Table 3.3.4 Depth of Wells (Max, Min and Ave) III-3-6
Table 3.3.5 Number of Wells Constructed by Year III-3-8
Table 3.3.6 Issues in Water Quality of Wells III-3-9
Table 3.4.1 Average Size of Farm Plot per Household (ha) III-3-10
Table 3.4.2 Average Size of Farm Plot per Family Member III-3-11
Table 3.5.1 Years of Experience in Paddy Cultivation III-3-11
Table 3.5.2 Number of Cultivation per Year (Paddy Farmer Only) III-3-12
Table 3.5.3 Rice Varieties Cultivated in the Surveyed Area III-3-12
Table 3.5.4 Reasons in Choosing Rice Varieties (Summary) III-3-13
Table 3.5.5 Reasons in Choosing Rice Varieties by Variety III-3-14
Table 3.5.6 Places to Obtain Rice Seeds III-3-15
Table 3.5.7 Establishing Method of Paddy III-3-15
Table 3.5.8 Yield of Paddy in Average Year III-3-16
Table 3.5.9 Yield of Paddy in Poor Harvesting Year III-3-16
Table 3.5.10 Years of Poor Harvesting of Paddy III-3-17
Table 3.5.11 Factors of Low Productivity in Poor Harvesting Year III-3-17
Table 3.5.12 Possessions of Agricultural Machineries for Paddy Cultivation III-3-18
Table 3.5.13 Agricultural Machineries Rented Out III-3-18
Table 3.5.14 Years of Purchasing Agricultural Machineries III-3-19
Table 3.5.15 Production and Estimated Gross Income from Paddy Cultivation per Household III-3-20
Table 3.5.16 Production and Estimated Gross Income from Paddy Cultivation per Hectare III-3-20

Table 3.5.17 Labor and Outsourcing Costs for Paddy Cultivation per Household III-3-21
Table 3.5.18 Cost of Inputs for Paddy Cultivation per Household III-3-22
Table 3.5.19 Number of Responses Applying Designated Inputs per Household III-3-22
Table 3.5.20 Amount of Fertilizer Applied per Hectare for Paddy Cultivation III-3-22
Table 3.5.21 Estimated Net Income from Paddy Cultivation III-3-23
Table 3.5.22 Summary of Net Income from Paddy Cultivation III-3-24
Table 3.6.1 Planted Area, Harvested Area, Selling Amount and Gross Income from Fruits III-3-25
Table 3.6.2 Years after Establishing Perennial Crops III-3-25
Table 3.6.3 Cost of Perennial Crop Production III-3-26
Table 3.6.4 Cost of Perennial Crop Production III-3-26
Table 3.7.1 Cost and Income from Livestock Production III-3-28
Table 3.8.1 Average Planted Area per Household by Cropping Pattern III-3-30
Table 3.8.2 Average Income and Expenditure from Major Commodities per Hectare III-3-30
Table 3.8.3 Average Number of Livestock per Household III-3-31
Table 3.8.4 Net Income from Standardized Livestock Rearing per Household (Simple) III-3-31
Table 3.8.5 Net Income from Averaged Livestock Rearing per Household (Detail) III-3-31
Table 3.8.6 Income from Major Cropping Pattern per Household III-3-32
Table 3.9.1 Types of Learning Opportunities to Gain Agricultural Technologies III-3-33
Table 3.9.2 Types of Topics Learned III-3-33
Table 3.10.1 Experience of Periodical Flood and Saline Intrusion III-3-33
Table 3.11.1 Climate Change Respondents Observed III-3-34
Table 3.11.2 Major Damages or Losses Caused by Climate Change III-3-35
Table 3.11.3 Countermeasures Taken by the Households III-3-36
Table 3.11.4 Saline Intrusion at Farmers' Field or Canals Nearby III-3-36
Table 4.1.1 Contents of Four Development Scenarios III-4-1
Table 4.2.1 Profitability of Major Commodities (000VND/ha) III-4-2
Table 4.2.2 Risk Factors and Their Impact on Major Commodities III-4-3
Table 4.2.3 Suitable Salinity Contents for Shrimp Culture III-4-4
Table 4.4.1 Typical Cropping Calendar in the Saline-Prone Areas III-4-7
Table 4.4.2 Criteria for the Land Use Planning for Paddy and Shrimp III-4-9
Table 4.4.3 Re-arrangement of Land Use Category III-4-11
Table 4.4.4 Current Land Use by Province for the Year of 2009 ..... III-4-12
Table 4.4.5 Current Land Use by Province for the Year of 2009 (Abstract) III-4-12
Table 4.4.6 Conversion Areas from Paddy to Other Land Use (2020) III-4-14
Table 4.4.7 Land Use for the Year 2020 (Abstract) III-4-15
Table 4.4.8 Land Use for the Year 2020 (All Items) III-4-15
Table 4.4.9 Change in Land Use from 2009 to 2020 ..... III-4-15
Table 4.4.10 Suitability Areas for Paddy and Shrimp Production (2030) III-4-18
Table 4.4.11 Land Use for the Year 2030 (Abstract) III-4-19
Table 4.4.12 Land Use for the Year 2030 (All Items) III-4-19
Table 4.4.13 Change in Land Use from 2009 to 2030 ..... III-4-19
Table 4.4.14 Suitability Areas for Paddy and Shrimp Production (2050) III-4-22
Table 4.4.15 Land Use for the Year 2050 (Abstract) III-4-23
Table 4.4.16 Land Use for the Year 2050 (All Items) III-4-23
Table 4.4.17 Change in Land Use from 2009 to 2050 ..... III-4-23

Table 4.4.18 Summary of Protection Area and Conversion Area (2020, 2030 and 2050) III-4-26
Table 4.4.19 Saline Prone Area for 2020 .... III-4-27
Table 4.4.20 Saline Prone Area for 2030 .... III-4-27
Table 4.4.21 Saline Prone Area for 2050 .... III-4-27
Table 4.4.22 Land Use Plan for the Year 2050 (Abstract: FINAL) III-4-33
Table 4.4.23 Land Use Plan for the Year 2050 (Complete: FINAL) III-4-33
Table 4.4.24 Change in Land Use frrom 2009 to 2050 (Final) III-4-33

LIST OF FIGURES

Figure 1.1.1 Agro-ecological Zones of Vietnam III-1-1
Figure 1.2.1 Transition of Land Use in Vietnam III-1-3
Figure 1.2.2 Transition of Agricultural Land Area and Its Composition III-1-4
Figure 1.3.1 Planted Area of Cereals by Region III-1-7
Figure 1.3.2 Planted Area of Cereals per Capita (ha) III-1-7
Figure 1.4.1 Harvested Area of Perennial Crops III-1-8
Figure 2.2.1 Soil Classification Map of the Mekong Delta III-2-2
Figure 2.2.2 Saline Intrusion in the Mekong Delta III-2-3
Figure 2.2.3 Land Use Map of the Mekong Delta as of 2008 ..... III-2-4
Figure 2.2.4 Agricultural Land Use per Total Land Area (%)) III-2-5
Figure 2.2.5 Agricultural Land Use per Total Agricultural Area (%) III-2-5
Figure 2.2.6 Paddy Production in Coastal Seven Provinces III-2-8
Figure 2.2.7 Yield of Paddy in the Project Area III-2-9
Figure 3.1.1 Location Map of Household Questionnaire Survey (Whole) III-3-2
Figure 3.1.2 Land Use of Surveyed Provinces III-3-3
Figure 3.2.1 Number of Sample Household by Number of Family Member III-3-4
Figure 3.3.1 Number of Wells Constructed III-3-7
Figure 3.3.2 Issues in Water Quality of Wells III-3-9
Figure 3.4.1 Frequency of the Responses by the Size of Farm Plot III-3-10
Figure 4.4.1 Concept of Land Use Criteria for Paddy-Shrimp Conversion III-4-8
Figure 4.4.2 Procedure of Land Use Planning and Mapping III-4-10
Figure 4.4.3 Composition of Current Land Use by Province III-4-12
Figure 4.4.4 Land Use Map for the Year 2009 ..... III-4-13
Figure 4.4.5 Assessment of Current Paddy Area by Salinity Level (2020) III-4-16
Figure 4.4.6 Land Use Map for the Year 2020 ..... III-4-17
Figure 4.4.7 Assessment of Current Paddy Area by Salinity Level (2030) III-4-20
Figure 4.4.8 Land Use Map for the Year 2030 ..... III-4-21
Figure 4.4.9 Assessment of Current Paddy Area by Salinity Level (2050) III-4-24
Figure 4.4.10 Land Use Map for the Year 2050 ..... III-4-25
Figure 4.4.11 Risk of Saline Intrusion to Paddy-based Cropping Systems (2020) III-4-28
Figure 4.4.12 Risk of Saline Intrusion to Paddy-based Cropping Systems (2030) III-4-29
Figure 4.4.13 Risk of Saline Intrusion to Paddy-based Cropping Systems (2050) III-4-30
Figure 4.4.14 Land Use Map for the Year 2050 (FINAL) III-4-32

CHAPTER 1 SALIENT FEATURE OF AGRICULTURE SECTOR

1.1 Agro-ecological Zones

Vietnam is divided into seven (7) to nine (9) agricultural zones[1][2][3], based on topography, climate, soil pattern and agro-economy. According to "Technical Report on the Characterisation of Agro-Ecological Context in Which Farm Animal Genetic Resources and Found (GEF-UNDP 2715-03-4709, 2004)," those ecological zones are summarized as follows:

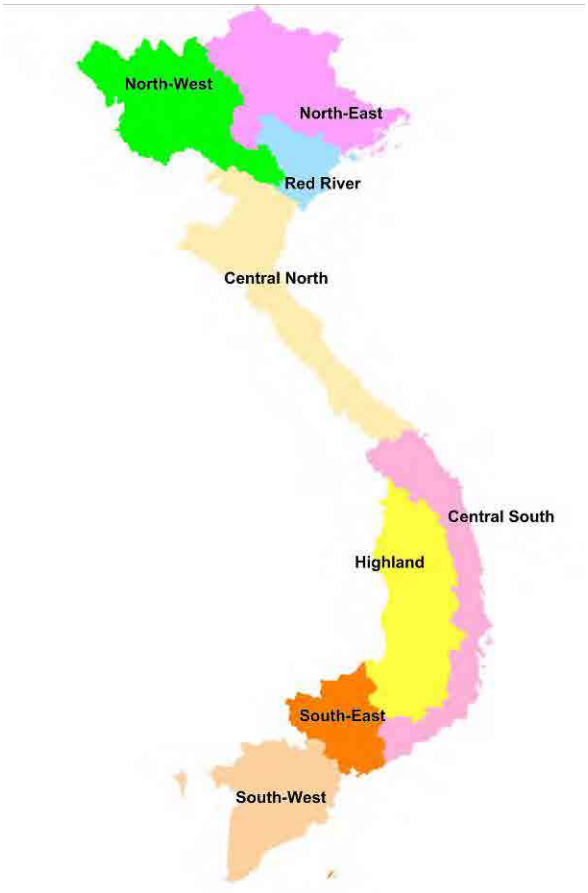


Figure 1.1.1 Agro-ecological Zones of Vietnam
Source: SIWRP (2011)

1. North East:

This is mountainous area with poor transportation facilities, poor market access. There are a lot of bare hills and small parcels of land with low productivity. It is considered an under developed zone except for Quang Ninh and Thai Nguyen provinces where there are some industries like coal, iron and tourism. Beside cereals, industrial trees especially tea are also developed. About farm animals, buffalo, pigs and scavenging chicken are popular.

2. North West:

The main features of this region are: a large land area, hills of bare stone mountains, isolated hamlets, little market opportunity, poor living standards and a low educational level. Tea and fruit trees are developed. Buffalo production is an advantage branch of animal husbandry here. Pig raising is also popular but the productivity of indigenous breeds is low. Keeping chickens to scavenge is popular. With lower temperature to compare with other zone make this place an appropriate zone for dairy production. The pure breed of Holstein Friesian cows can adapt to this area. The shortage of transportation, communication facilities and irrigation systems are limited factors for economic development in this region.

3. Red River Delta:

The Red River Delta is the rice bowl of the country. It is characterized by a high population density and scarcity of land. Cereals are main products. The level of education is good, technical skills are high and markets are developed. There is a high consumption of animal products in the big cities. Cattle production is well developed. Local pig breeds are being replaced by imported breeds. There is a broiler industry in addition to scavenging chicken. However, the job generation is a big problem, due to the dense population.

[1] FAO stands on nine zones, http://www.fao.org/ag/AGP/AGPC/doc/Counprof/vietnam/agromap.htm
[2] Institute of Agricultural Science of South Vietnam (IAS) pleas it seven in its PPT presentation.
[3] A technical report stated it is eight, http://www.fangrasia.org/admin/admin_content/files/97104.pdf

4. North Central Coast:

This is a narrow strip, dominated by mountains in the West. There is a tendency for an increase in industrial crops such as peanuts, coffee and rubber. Markets are underdeveloped. Cattle and buffalo production have developed parallel with each other. Pig production is based on a mixture of local breeds and crossbred animals. This is a food deficit and a poor area.

5. South Central Coast:

In this region there are large populations in the cities. The market potential is larger compared with the Northern Central Coast. Beef production is well developed. Pig stocks are dominated by crossbred animals. Goat and sheep are raised in the dry areas. Aquaculture and fish industries have been developed. This region is characterized by a prolonged dry season, so animal feed is a big constraint for livestock development especially upon large ruminant.

6. Central Highlands:

This region is famous for industrial crops such as coffee and rubber. The dry season is prolonged and the lack of water resources is the most limiting feature of the region. Deforestation is also a big problem. Cattle production is developed. Pig breeds consist of local and crossbred. In the dry season, shortage of animal feed (forage) is a big problem.

7. South East:

This is a peri-urban area, where there is an advantage in ease of marketing. Industrial crop development is promising: e.g. coffee, sugar cane, cashews. There are large amounts of by-products (brewery residue, oil cake). Most of the pig, chicken and duck breeds are improved breeds. Dairying is also developed. The educational level of the people is high.

8. Mekong River Delta:

This is the known as the "Rice basket" of Vietnam. Rice straw is a main byproduct. Fishing and shrimp production are also developed. The majority of pig breeds are crossbred. Post-harvest losses and environmental pollution are big problems. It is clear that there are wide variations in both natural and economic characteristics and educational levels within these regions and especially in market opportunity. Therefore, the kind of manufactured products and technology to produce products must be considered and the decision should be on appropriate way for each region.

1.2 Agricultural Land Use

1) Agricultural Land Use

As of 2009, agricultural land of Vietnam reaches 10,272,000ha, which accounts for 33% of total land area (Table 1.2.1). Of the agricultural area, arable land (6,280,000ha) shares 61%, permanent crops (3,350,000ha) 33%, and permanent meadows and pastures (642,000ha) 6%. Area equipped with irrigation[4] (4,600,000ha) reached 45% of the total agricultural area. Assuming that all those areas are in the category of arable land, it would account for 73% of the arable land. In addition, forest area (13,653,000ha) shares 44%, the most significant part of the land area in this country.

[4] Area Equipped for Irrigation: Area equipped to provide water (via irrigation) to the crops. It includes areas equipped for full and partial control irrigation, equipped lowland areas, pastures, and areas equipped for spate irrigation (FAOSTAT).

Table 1.2.1 Total Land Use of Vietnam (2009)

item	Area (2009)	% to Land Area	% to Agricultural Area
Country area	33,105	-	-
Land area	31,007	100%	-
Agricultural area	10,272	33%	100%
Arable land	6,280	20%	61%
Permanent crops	3,350	11%	33%
Permanent meadows and pastures	642	2%	6%
Forest area	13,653	44%	
Other land	7,082	23%	
Inland water	2,098	7%	
Total area equipped for irrigation	4,600	15%	45%

Source: FAOSTAT (as of Sep. 2011) Unit: thousand ha

Figure 1.2.21 shows the trend of major land use in Vietnam for the past two decades[5]. As illustrated, both forest area and agricultural area have increased, while the other land has lost its share. In fact, forest area has increased 4,290,000ha from 9,363,000ha to 13,653,000ha; 46% of increase from 1990 to 2009 (Table 1.2.21.). Similarly, agricultural area has increased by 53% from 6,715,000ha to 10,272,000ha in the same period.

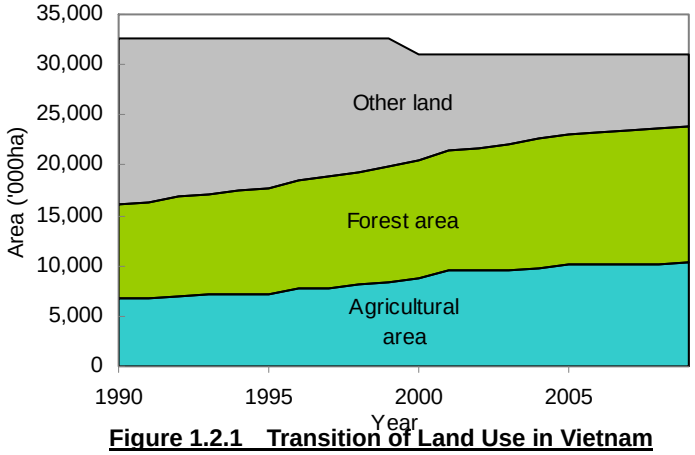


Figure 1.2.1 Transition of Land Use in Vietnam

Source: FAOSTAT (as of Sep 2011)

Looking at the detailed composition of agricultural area, increase in permanent crops has contributed to this significant increase of the total agricultural area. As shown in Figure 1.2.2, while arable land has almost remained at around 6,000,000ha, permanent crops has been tripled from 1,045,000ha (1990) to 3,350,000ha (2009) (see Table 1.2.2). This considerable increase can be largely attributed to the government's policy on the development of new economic zones, which has been carried out from 1961 to 1998 in two phases[6]. Under the policy, teeming population in the urban area, especially in red river delta, had been encouraged to move to uncultivated highland/midland of northern region. In the period of 1976 to 1998, particularly, a large number of populations, including the large number of populations from Ho Chi Minh City in this phase, have been moved to central highland and its southern provinces. As the unexploited areas were rich in virgin soil and thus suited to perennial crops, a vast range of area have been turned into the area under "permanent crops."

[5] Total land area of the country itself has been amended (reduced) three times during this period based on the agreements with neighboring countries (China in 1999, and Cambodia in 2004 and 2007).

[6] According to an interview to SIWRP counterpart personnel (2011)

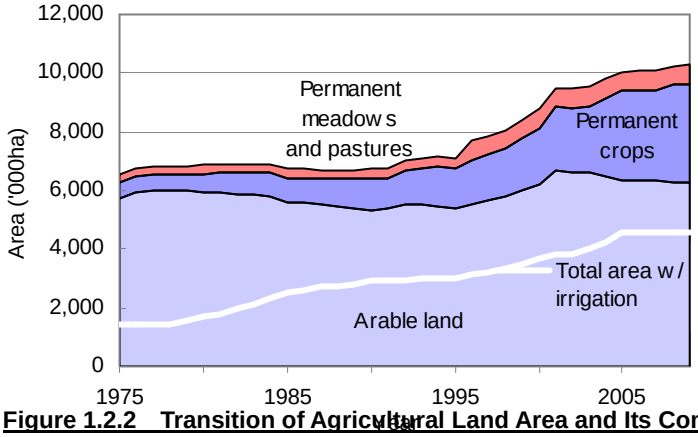


Figure 1.2.2 Transition of Agricultural Land Area and Its Composition

Source: FAOSTAT (as of Sep 2011)

Table 1.2.2 Total Land Use of Vietnam (1961-2009)

item	Country area	Land area	Agricultural area	Arable land	Permanent crops	Permanent meadows and	Forest area	Other land	Inland water	Total area w/ irrigation
1961	33,169	32,549	6,292	5,550	470	272			620	1,000
1962	33,169	32,549	6,297	5,550	475	272			620	1,000
1963	33,169	32,549	6,302	5,550	480	272			620	1,000
1964	33,169	32,549	6,307	5,550	485	272			620	1,000
1965	33,169	32,549	6,312	5,550	490	272			620	1,000
1966	33,169	32,549	6,317	5,550	495	272			620	1,000
1967	33,169	32,549	6,342	5,570	500	272			620	1,100
1968	33,169	32,549	6,367	5,590	505	272			620	1,100
1969	33,169	32,549	6,382	5,600	510	272			620	1,100
1970	33,169	32,549	6,417	5,630	515	272			620	1,200
1971	33,169	32,549	6,422	5,630	520	272			620	1,200
1972	33,169	32,549	6,447	5,650	525	272			620	1,200
1973	33,169	32,549	6,482	5,680	530	272			620	1,300
1974	33,169	32,549	6,507	5,700	535	272			620	1,300
1975	33,169	32,549	6,512	5,700	540	272			620	1,400
1976	33,169	32,549	6,722	5,900	550	272			620	1,400
1977	32,957	32,549	6,812	5,980	560	272			408	1,400
1978	32,957	32,549	6,836	5,999	565	272			408	1,401
1979	33,161	32,549	6,850	5,970	600	280			612	1,555
1980	33,169	32,549	6,858	5,940	630	288			620	1,700
1981	33,169	32,549	6,876	5,910	670	296			620	1,800
1982	33,169	32,549	6,884	5,880	700	304			620	2,000
1983	33,169	32,549	6,902	5,850	740	312			620	2,100
1984	33,169	32,549	6,910	5,820	770	320			620	2,300
1985	33,169	32,549	6,750	5,616	805	329			620	2,500
1986	33,169	32,549	6,725	5,570	830	325			620	2,600
1987	33,035	32,549	6,710	5,527	860	323			486	2,700
1988	33,036	32,549	6,710	5,460	920	330			487	2,700
1989	33,036	32,549	6,715	5,400	980	335			487	2,800
1990	33,103	32,549	6,726	5,339	1,045	342	9,363	16,460	554	2,900
1991	33,106	32,549	6,751	5,368	1,057	326	9,599	16,199	557	2,900
1992	33,109	32,549	7,025	5,506	1,191	328	9,835	15,689	560	2,900
1993	33,111	32,549	7,087	5,516	1,243	328	10,072	15,390	562	3,000
1994	33,111	32,549	7,140	5,464	1,348	328	10,308	15,101	562	3,000
1995	33,111	32,549	7,079	5,403	1,348	328	10,544	14,926	562	3,000
1996	33,111	32,549	7,682	5,554	1,450	678	10,780	14,087	562	3,150
1997	33,111	32,549	7,844	5,668	1,534	642	11,016	13,689	562	3,200
1998	33,111	32,549	8,055	5,763	1,650	642	11,253	13,241	562	3,350
1999	33,111	32,549	8,413	6,000	1,771	642	11,489	12,647	562	3,500
2000	32,924	31,106	8,780	6,200	1,938	642	11,725	10,601	1,818	3,650
2001	32,925	31,109	9,483	6,649	2,192	642	11,995	9,631	1,816	3,850
2002	32,930	31,055	9,455	6,600	2,213	642	12,266	9,334	1,875	3,850
2003	32,931	31,007	9,537	6,581	2,314	642	12,536	8,934	1,924	4,000
2004	32,931	31,007	9,796	6,470	2,684	642	12,807	8,405	1,924	4,200
2005	33,121	31,007	10,054	6,358	3,054	642	13,077	7,876	2,114	4,585
2006	33,121	31,007	10,078	6,348	3,088	642	13,221	7,708	2,114	4,600
2007	33,121	31,007	10,063	6,310	3,111	642	13,365	7,579	2,114	4,600
2008	33,105	31,007	10,241	6,283	3,316	642	13,509	7,257	2,098	4,600
2009	33,105	31,007	10,272	6,280	3,350	642	13,653	7,082	2,098	4,600

Source: FAOSTAT (as of Sep 2011)

2) Agricultural Land Tax

The government of Vietnam maintains a series of tax including land use tax for agricultural and aquacultural production. The tax had been applied to all the registered farm plots and, for paddy fields, 10kg/360m^2 had been applied (Interview to the CP in SIWRP). However, the land tax for paddy fields had been suspended since 2003 to date. Reportedly, the tax exemption accounted for a total of two (2) million tons of rice for around 11.2 million farmer households a year[7], which is equivalent to approximately 50,000VND per farmer per year. Besides, the tax exemption is expected to be effective until 2020 upon the approval by the National Assembly and Peoples' Council[8].

According to Circular 120/2011/TT-BTC, which is effective from October 1, 2011, the agricultural land use tax are fully exempted for the agricultural land which is: 1) used for research and experimental production where annual crops are planted yearly (at least one rice crop a year); 2) for salt production allocated or earmarked for poor households; and 3) allocated to farmers and farmer households for agricultural production[9].

1.3 Crop Production Production of the Country

1) Crop Production

Planted areas of annual crops and perennial crops are shown in Table 1.3.1. Of 13,925,400 ha of total area, 80% is planted under annual crops and 20% for perennial crops. In fact, cereal crops share 62% of the total planted area.

Table 1.3.1 Planted Area of Annual Crops and Perennial Crops Thousand ha

Year	Total	Annual Crops			Perennial Crops		
		Total	Cereals	Industrial	Total	Industrial	Fruit Crops
2000	12,644.3	10,540.3	8,399.1	778.1	2,104.0	1,451.3	565.0
2001	12,507.0	10,352.2	8,224.7	786.0	2,154.8	1,475.8	609.6
2002	12,831.4	10,595.9	8,322.5	845.8	2,235.5	1,491.5	677.5
2003	12,983.3	10,680.1	8,366.7	835.0	2,303.2	1,510.8	724.5
2004	13,184.5	10,817.8	8,437.8	857.1	2,366.7	1,554.3	746.8
2005	13,287.0	10,818.8	8,383.4	861.5	2,468.2	1,633.6	767.4
2006	13,409.8	10,868.2	8,359.7	841.7	2,541.6	1,708.6	771.4
2007	13,555.6	10,894.9	8,304.7	846.0	2,660.7	1,821.7	778.5
2008	13,872.9	11,156.7	8,542.2	806.1	2,716.2	1,885.8	775.5
2009	13,807.6	11,047.1	8,527.4	753.6	2,760.5	1,936.0	774.0
2010	13,925.4	11,110.3	8,641.4	800.2	2,815.1	1,987.4	776.3
Percentage	100%	80%	62%	6%	20%	14%	6%

Source: Statistical Yearbook of Vietnam (2010)

Note: a sum of cereals and industrial does not correspond the value of total annual crop. Probably, the "total" may include others.

Furthermore, Table 1.3.2 shows planted area of main annual crops in Vietnam. Significantly, the planted area of paddy reached 7,513,700ha, 80% of the total planted area of annual crops as of 2010. Looking at the trend in planted area of paddy field in the past 11 years, it has been at same level or slightly decreased. Notwithstanding the constant planted area of paddy, its production has increased by 23% from 2000 (32,529,500 tons) to 2010 (39,988,900tons) (see Table 1.3.3). This increase is therefore totally attributed to the ever improving yield level of paddy. As shown in Table 1.3.4, an average yield estimated from the total production and total planted area had increased from 4.2 ton/ha to 5.3 ton/ha from 2000 to 2010, which accounts for 25% of increase. Development and extension of high-yielding varieties, construction of irrigation facilities and thus improved farming system might have supported this improvement.

[7] Vietnam Business News, http://vietnambusiness.asia/no-tax-on-farmers-for-agricultural-land/

[8] VietNews, http://www.dztimes.net/post/politics/vietnam-to-ponder-agriculture-land-tax-reduction.aspx

[9] The ministry of Finance, http://www.mof.gov.vn/portal/page/portal/mof_en/dn?p_page_id=2522361&item_id=45543638&p_details=1

Table 1.3.2 Planted Area of Main Annual Crops

Thousand ha

Year	Paddy	% to 2000	Maize	Sugar-cane	Cotton	Peanut	Soya-bean	Total
2000	7,666.3	100%	730.2	302.3	18.6	244.9	124.1	9,087.4
2001	7,492.7	98%	729.5	290.7	27.7	244.6	140.3	8,926.5
2002	7,504.3	98%	816.0	320.0	34.1	246.7	158.6	9,080.7
2003	7,452.2	97%	912.7	313.2	27.8	243.8	165.6	9,116.3
2004	7,445.3	97%	991.1	286.1	28.0	263.7	183.8	9,199.0
2005	7,329.2	96%	1,052.6	266.3	25.8	269.6	204.1	9,148.6
2006	7,324.8	96%	1,033.1	288.1	20.9	246.7	185.6	9,100.2
2007	7,207.4	94%	1,096.1	293.4	12.1	254.5	187.4	9,051.8
2008	7,400.2	97%	1,140.2	270.7	5.8	255.3	192.1	9,265.3
2009	7,437.2	97%	1,089.2	265.6	9.6	245.0	147.0	9,194.6
2010	7,513.7	98%	1,126.9	266.3	9.1	231.0	197.8	9,345.8
Percentage	80%		12%	3%	0%	2%	2%	100%

Source: Statistical Yearbook of Vietnam (2010)

Table 1.3.3 Production of Main Annual Crops

Thousand tons

Year	Paddy	% to 2000	Maize	Sugar-cane	Cotton	Peanut	Soya-bean
2000	32,529.5	100%	2,005.9	15,044.3	18.8	355.3	149.3
2001	32,108.4	99%	2,161.7	14,656.9	33.6	363.1	173.7
2002	34,447.2	106%	2,511.2	17,120.0	40.0	400.4	205.6
2003	34,568.8	106%	3,136.3	16,854.7	35.1	406.2	219.7
2004	36,148.9	111%	3,430.9	15,649.3	28.0	469.0	245.9
2005	35,832.9	110%	3,787.1	14,948.7	33.5	489.3	292.7
2006	35,849.5	110%	3,854.6	16,719.5	28.6	462.5	258.1
2007	35,942.7	110%	4,303.2	17,396.7	16.1	510.0	275.2
2008	38,729.8	119%	4,573.1	16,145.5	8.0	530.2	267.6
2009	38,950.2	120%	4,371.7	15,608.3	12.1	510.9	215.2
2010	39,988.9	123%	4,606.8	15,946.8	13.3	485.7	296.9

Source: Statistical Yearbook of Vietnam (2010)

Table 1.3.4 Yield of Main Annual Crops

ton/ha

Year	Paddy	% to 2000	Maize	Sugar-cane	Cotton	Peanut	Soya-bean
2000	4.2	100%	2.7	49.8	1.0	1.5	1.2
2001	4.3	101%	3.0	50.4	1.2	1.5	1.2
2002	4.6	108%	3.1	53.5	1.2	1.6	1.3
2003	4.6	109%	3.4	53.8	1.3	1.7	1.3
2004	4.9	114%	3.5	54.7	1.0	1.8	1.3
2005	4.9	115%	3.6	56.1	1.3	1.8	1.4
2006	4.9	115%	3.7	58.0	1.4	1.9	1.4
2007	5.0	118%	3.9	59.3	1.3	2.0	1.5
2008	5.2	123%	4.0	59.6	1.4	2.1	1.4
2009	5.2	123%	4.0	58.8	1.3	2.1	1.5
2010	5.3	125%	4.1	59.9	1.5	2.1	1.5

Source: Statistical Yearbook of Vietnam (2010)

2) Crop Production by Region

As shown in Table 1.3.5, the planted area of cereals in 2010 reached around 8,641,400 ha in the country, in which Mekong River Delta alone shares 46.4% (Figure 1.3.1). The second largest is North Central and Central Coastal Areas (16.5%), which is followed by Red River Delta (14.4%). Accordingly, 49%, almost a half of total production in the country was produced in Mekong River Delta. This massive amount of production in Mekong River Delta is largely attributed to considerably large planted areas per capita.

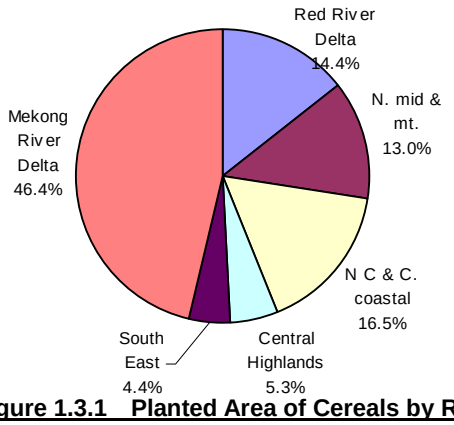


Figure 1.3.1 Planted Area of Cereals by Region

Source: Statistical Yearbook of Vietnam (2010)

Table 1.3.5 Cereal Production in 2010

Region	Planted Area (thousand ha)	%	Production (thousand ha)	%	Planted Area per Capita (ha)	%	Production per Capita (kg)	%
WHOLE COUNTRY	8,641.4	100%	44,596.6	100%	0.10	100%	513.0	100%
Red River Delta	1,247.8	14%	7,244.6	16%	0.06	63%	366.4	71%
Northern midlands and mountain areas	1,124.7	13%	4,608.4	10%	0.10	101%	412.6	80%
North Central and Central coastal areas	1,428.4	17%	7,006.2	16%	0.08	76%	370.0	72%
Central Highlands	453.7	5%	2,211.9	5%	0.09	88%	424.2	83%
South East	378.5	4%	1,756.0	4%	0.03	26%	120.6	24%
Mekong River Delta	4,008.3	46%	21,769.5	49%	0.23	233%	1,260.4	246%

Source: Statistical Yearbook of Vietnam (2010)

As illustrated in Figure 1.3.2, the planted area of cereals per capita was 0.23ha in Mekong Rive Delta, which accounts for 233% of average size in the country. In fact, excepting Northern Midlands and Mountain Areas, all the other regions resulted in less than national average. Thus, as far as cereal production is concerned, Mekong River Delta plays a significant role in terms of the area planted and production.

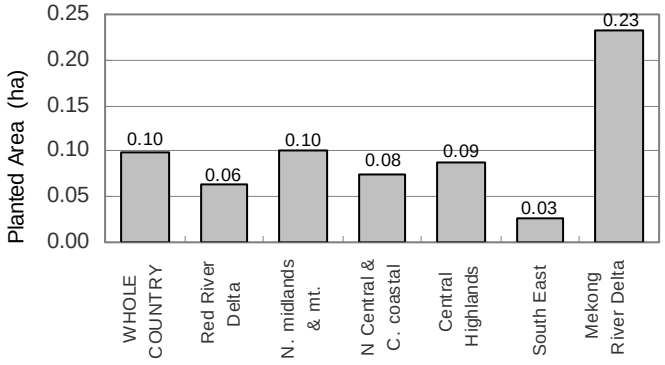


Figure 1.3.2 Planted Area of Cereals per Capita (ha)

Source: FAOSTAT (as of Sep 2011)

1.4 Perennial Crops

As briefly discussed in Chapter 1.2, harvested area of perennial crops has significantly increased in the past two decades. Also illustrated as Figure 1.4.1, this continuous increase has attributed to a firm increase of fruit crops, coffee, and cashew nuts. As also shown in Table 1.4.1, areas harvested for fruits, coffees, and cashewnuts, have become 2.7, 24, and 321 times as much as they were in 1961. Harvested areas of those categories in 2008 were 1.8, 54 and 40 times as much as they were in 1980—such significant increases.

As of the year 2008, the share in harvested area of perennial crops is composed of 36% in coffee, 30% in fruits, 23% in cashew nuts, 8% in tea, and 3% in pepper. Note that the harvested area of pepper is comparatively small but the increase in the past three decades is significant: from 426ha in 1980 to 42,400ha in 2008—100 times of increase. After all, Vietnam's agriculture has experienced a significant structural change in accordance with the government's resettlement policy.

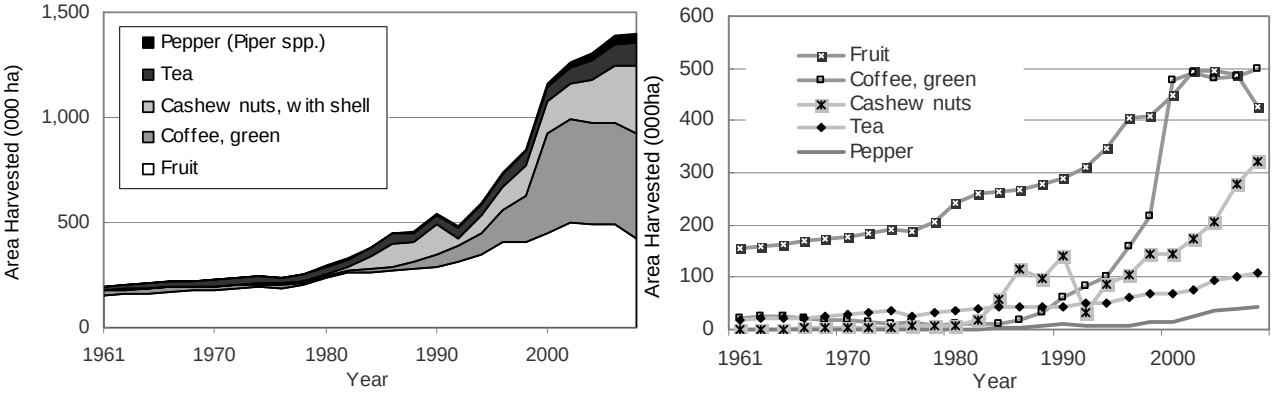


Figure 1.4.1 Harvested Area of Perennial Crops
Source: FAOSTAT (as of Sep 2011)

Table 1.4.1 Harvested Area of Major Perennial Crops (1961-2008)

Year	Perennial Crops Total			Fruits			Coffee, green			Cashew nuts			Tea		Pepper		
	Area (ha)	Trend (1961=1)	Trend (1980=1)	Area (ha)	Trend (1961=1)	Trend (1980=1)	Area (ha)	Trend (1961=1)	Trend (1980=1)	Area (ha)	Trend (1961=1)	Trend (1980=1)	Area (ha)	Trend (1961=1)	Area (ha)	Trend (1961=1)	Trend (1980=1)
1961	196,785	1.0		155,185	1.0		21,200	1		1,000	1		19,100	1.0	300	1	
1962	204,395	1.0		157,685	1.0		24,410	1		1,000	1		21,000	1.1	300	1	
1964	212,385	1.1		164,085	1.1		25,000	1		1,000	1		22,000	1.2	300	1	
1966	217,120	1.1		169,130	1.1		22,200	1		3,000	3		22,400	1.2	390	1	
1968	221,125	1.1		174,775	1.1		18,000	1		3,000	3		25,000	1.3	350	1	
1970	228,415	1.2		177,275	1.1		18,600	1		3,000	3		29,200	1.5	340	1	
1972	240,060	1.2		185,800	1.2		16,000	1		5,000	5		33,000	1.7	260	1	
1974	244,120	1.2		190,800	1.2		12,000	1		5,000	5		36,000	1.9	320	1	
1976	238,206	1.2		188,996	1.2		15,500	1		7,000	7		25,900	1.4	810	3	
1978	256,283	1.3		206,950	1.3		8,130	0		7,000	7		33,800	1.8	403	1	
1980	292,757	1.5	1.0	240,441	1.5	1.0	9,200	0	1	8,000	8	1	34,690	1.8	426	1	1
1982	327,080	1.7	1.1	259,000	1.7	1.1	10,960	1	1	17,000	17	2	38,920	2.0	1,200	4	3
1984	380,001	1.9	1.3	265,650	1.7	1.1	11,830	1	1	59,000	59	7	41,600	2.2	1,921	6	5
1986	450,600	2.3	1.5	268,400	1.7	1.1	19,100	1	2	115,000	115	14	44,200	2.3	3,900	13	9
1988	458,870	2.3	1.6	278,570	1.8	1.2	32,300	2	4	97,000	97	12	43,400	2.3	7,600	25	18
1990	544,009	2.8	1.9	288,556	1.9	1.2	61,857	3	7	140,000	140	18	44,400	2.3	9,196	31	22
1992	481,164	2.4	1.6	310,964	2.0	1.3	81,800	4	9	32,000	32	4	50,000	2.6	6,400	21	15
1994	593,495	3.0	2.0	347,395	2.2	1.4	99,900	5	11	88,000	88	11	51,700	2.7	6,500	22	15
1996	734,396	3.7	2.5	403,196	2.6	1.7	157,500	7	17	106,000	106	13	60,200	3.2	7,500	25	18
1998	849,779	4.3	2.9	407,300	2.6	1.7	218,300	10	24	144,500	145	18	66,879	3.5	12,800	43	30
2000	1,157,482	5.9	4.0	449,582	2.9	1.9	476,900	22	52	145,800	146	18	70,300	3.7	14,900	50	35
2002	1,263,955	6.4	4.3	495,955	3.2	2.1	492,500	23	54	173,200	173	22	77,200	4.0	25,100	84	59
2004	1,306,053	6.6	4.5	494,053	3.2	2.1	479,100	23	52	204,300	204	26	92,400	4.8	36,200	121	85
2006	1,391,301	7.1	4.8	488,701	3.1	2.0	483,200	23	53	276,800	277	35	102,100	5.3	40,500	135	95
2008	1,397,923	7.1	4.8	425,423	2.7	1.8	500,200	24	54	321,100	321	40	108,800	5.7	42,400	141	100
Ratio	100%			30%			36%			23%			8%		3%		

Source: FAOSTAT (as of September 2011)
Note: Ratio of each crop type is based on the result of year 2008
"Fruits" shows a total of those fruits: Bananas, Berries Nes, Fruit Fresh Nes, Grapefruit (inc. pomelos), Grapes, Mangoes, mangosteens, guavas, Oranges, and Pineapples

In addition, production of major perennial crops is shown in Table 1.4.2; production of perennial crops all had increased 6.1 times from 1961 and 3.2 times from 1980 to be 8,271,684 tons in 2008. Among them, increase of cashew nuts is significant in accordance with the increase of planted area; 220 times as much as that of 1980, while the increase of fruits production is relatively moderate.

Table 1.4.2 Production of Major Perennial Crops (1961-2008)

Year	Perennial Crops Total			Fruits			Coffee, green			Cashew nuts			Tea		Pepper		
	Prduction (ton)	Trend (1961=1)	Trend (1980=1)	Prduction (ton)	Trend (1961=1)	Trend (1980=1)	Prduction (ton)	Trend (1961=1)	Trend (1980=1)	Prduction (ton)	Trend (1961=1)	Trend (1980=1)	Prduction (ton)	Trend (1961=1)	Prduction (ton)	Trend (1961=1)	Trend (1980=1)
1961	1,360,885	1.0		1,348,135	1.0		4,100	0		700	1		7,500	1.0	450	1	
1962	1,376,360	1.0		1,363,690	1.0		4,020	0		700	1		7,500	1.0	450	1	
1964	1,455,060	1.1		1,439,410	1.1		5,500	0		700	1		9,000	1.2	450	1	
1966	1,559,680	1.1		1,538,840	1.1		6,300	0		2,100	3		12,000	1.6	440	1	
1968	1,641,795	1.2		1,619,745	1.2		6,000	0		2,100	3		13,500	1.8	450	1	
1970	1,693,885	1.2		1,669,375	1.2		7,300	0		2,100	3		14,700	2.0	410	1	
1972	1,738,000	1.3		1,712,000	1.3		7,000	0		3,500	5		15,000	2.0	500	1	
1974	1,745,850	1.3		1,719,000	1.3		6,000	0		3,500	5		17,000	2.3	350	1	
1976	1,733,472	1.3		1,700,900	1.3		9,700	0		4,900	7		17,251	2.3	721	2	
1978	2,074,037	1.5		2,043,400	1.5		5,400	0		4,900	7		20,040	2.7	297	1	
1980	2,608,209	1.9	1.0	2,572,639	1.9	1.0	8,400	0	1	5,600	8	1	21,014	2.8	556	1	1
1982	2,821,047	2.1	1.1	2,779,500	2.1	1.1	5,300	0	1	10,000	14	2	25,378	3.4	869	2	2
1984	2,849,811	2.1	1.1	2,776,400	2.1	1.1	4,800	0	1	40,000	57	7	27,428	3.7	1,183	3	2
1986	3,226,593	2.4	1.2	3,088,000	2.3	1.2	25,000	1	3	80,000	114	14	30,006	4.0	3,587	8	6
1988	3,316,817	2.4	1.3	3,158,900	2.3	1.2	42,000	2	5	80,000	114	14	29,743	4.0	6,174	14	11
1990	3,475,169	2.6	1.3	3,199,712	2.4	1.2	92,000	4	10	140,000	200	25	32,247	4.3	11,210	25	20
1992	3,663,500	2.7	1.4	3,403,121	2.5	1.3	119,200	6	13	94,800	135	17	36,200	4.8	10,179	23	18
1994	4,117,293	3.0	1.6	3,675,723	2.7	1.4	180,000	8	20	208,000	297	37	42,000	5.6	11,570	26	21
1996	4,754,247	3.5	1.8	4,137,247	3.1	1.6	320,100	15	35	236,400	338	42	46,800	6.2	13,700	30	25
1998	4,801,290	3.5	1.8	4,090,790	3.0	1.6	409,300	19	44	216,000	309	39	56,600	7.5	28,600	64	51
2000	5,556,497	4.1	2.1	4,362,697	3.2	1.7	802,500	38	87	270,400	386	48	69,900	9.3	51,000	113	92
2002	6,171,138	4.5	2.4	4,801,438	3.6	1.9	699,500	33	76	515,200	736	92	94,200	12.6	60,800	135	109
2004	7,440,220	5.5	2.9	5,492,700	4.1	2.1	913,800	43	99	818,800	1,170	146	119,500	15.9	95,420	212	172
2006	8,226,905	6.0	3.2	5,895,635	4.4	2.3	985,300	46	107	1,092,400	1,561	195	151,000	20.1	102,570	228	184
2008	8,271,684	6.1	3.2	5,668,994	4.2	2.2	1,067,400	50	116	1,234,000	1,763	220	173,500	23.1	127,790	284	230

Source: FAOSTAT (as of September 2011)
Note: Ratio of each crop type is based on the result of year 2008
"Fruits" shows a total of those fruits: Bananas, Berries Nes, Fruit Fresh Nes, Grapefruit (inc. pomelos), Grapes, Mangoes, mangosteens, guavas, Oranges, and Pineapples

Those increases of production might have stemmed from increase in the yield. As shown in Table 1.4.3, yield of cashew nuts has increased 5.5 times in the past three decades, which is followed by coffee and pepper; both of them became 2.3 times in the same period. The yield of fruits, on the other hand, had increased only 20%. Therefore, this tremendous increase in perennial crops productions in the past few decades has been supported by both increases in area and yield level.

Table 1.4.3 Production of Major Perennial Crops (1961-2008)

Year	Fruits			Coffee, green			Cashew nuts			Tea		Pepper		
	Yield (t/ha)	Trend (1961=1)	Trend (1980=1)	Yield (t/ha)	Trend (1961=1)	Trend (1980=1)	Yield (t/ha)	Trend (1961=1)	Trend (1980=1)	Yield (t/ha)	Trend (1961=1)	Yield (t/ha)	Trend (1961=1)	Trend (1980=1)
1961	8.7	1.0		0.2	1.0		0.7	1.0		0.4	1.0	1.5	1.0	
1962	8.6	1.0		0.2	0.9		0.7	1.0		0.4	0.9	1.5	1.0	
1964	8.8	1.0		0.2	1.1		0.7	1.0		0.4	1.0	1.5	1.0	
1966	9.1	1.0		0.3	1.5		0.7	1.0		0.5	1.4	1.1	0.8	
1968	9.3	1.1		0.3	1.7		0.7	1.0		0.5	1.4	1.3	0.9	
1970	9.4	1.1		0.4	2.0		0.7	1.0		0.5	1.3	1.2	0.8	
1972	9.2	1.1		0.4	2.3		0.7	1.0		0.5	1.2	1.9	1.3	
1974	9.0	1.0		0.5	2.6		0.7	1.0		0.5	1.2	1.1	0.7	
1976	9.0	1.0		0.6	3.2		0.7	1.0		0.7	1.7	0.9	0.6	
1978	9.9	1.1		0.7	3.4		0.7	1.0		0.6	1.5	0.7	0.5	
1980	10.7	1.2	1.0	0.9	4.7	1.0	0.7	1.0	1.0	0.6	1.5	1.3	0.9	1.0
1982	10.7	1.2	1.0	0.5	2.5	0.5	0.6	0.8	0.8	0.7	1.7	0.7	0.5	0.6
1984	10.5	1.2	1.0	0.4	2.1	0.4	0.7	1.0	1.0	0.7	1.7	0.6	0.4	0.5
1986	11.5	1.3	1.1	1.3	6.8	1.4	0.7	1.0	1.0	0.7	1.7	0.9	0.6	0.7
1988	11.3	1.3	1.1	1.3	6.7	1.4	0.8	1.2	1.2	0.7	1.7	0.8	0.5	0.6
1990	11.1	1.3	1.0	1.5	7.7	1.6	1.0	1.4	1.4	0.7	1.8	1.2	0.8	0.9
1992	10.9	1.3	1.0	1.5	7.5	1.6	3.0	4.2	4.2	0.7	1.8	1.6	1.1	1.2
1994	10.6	1.2	1.0	1.8	9.3	2.0	2.4	3.4	3.4	0.8	2.1	1.8	1.2	1.4
1996	10.3	1.2	1.0	2.0	10.5	2.2	2.2	3.2	3.2	0.8	2.0	1.8	1.2	1.4
1998	10.0	1.2	0.9	1.9	9.7	2.1	1.5	2.1	2.1	0.8	2.2	2.2	1.5	1.7
2000	9.7	1.1	0.9	1.7	8.7	1.8	1.9	2.6	2.6	1.0	2.5	3.4	2.3	2.6
2002	9.7	1.1	0.9	1.4	7.3	1.6	3.0	4.2	4.2	1.2	3.1	2.4	1.6	1.9
2004	11.1	1.3	1.0	1.9	9.9	2.1	4.0	5.7	5.7	1.3	3.3	2.6	1.8	2.0
2006	12.1	1.4	1.1	2.0	10.5	2.2	3.9	5.6	5.6	1.5	3.8	2.5	1.7	1.9
2008	13.3	1.5	1.2	2.1	11.0	2.3	3.8	5.5	5.5	1.6	4.1	3.0	2.0	2.3

Source: FAOSTAT (as of September 2011)
Note: Ratio of each crop type is based on the result of year 2008
"Fruits" shows a total of those fruits: Bananas, Berries Nes, Fruit Fresh Nes, Grapefruit (inc. pomelos), Grapes, Mangoes, mangosteens, guavas, Oranges, and Pineapples

CHAPTER 2 AGRICULTURE IN THE PROJECT AREA

2.1 Farming Systems in the Mekong Delta

Farming systems in the Mekong Delta are quite diversified. So-called "rice bowl" rice production area is featured by strategic combinations of paddy, fruit trees, and aquaculture depending on location-specific conditions of agro-ecological environment. One of those farming systems is repeated production of paddy: two to three times of paddy productions a year.

Another example is a combination of paddy production and aquaculture especially shrimp. In the coastal area of Mekong delta, there are vast ranges of areas where seasonal salinity intrusion takes place. In such areas, brackish-water shrimp culture is often practiced during the dry season and then paddy production is organized in the rainy season in the same farm plot. In this system, brackish water shrimp production and fresh water paddy production are alternatively carried out in the same place.

One may say it seems impossible or not recommendable. However, it is manageable and actually being done in the vast area due to the seasonal tidal change coupled with an increased water level in the Mekong River and abundant precipitation—salinity can be washed away or leached out by fresh water in the rainy season. Thus, farmers orchestrate different types of crops/commodities given the availability of brackish/fresh water, technical competency, and financial capability.

Furthermore, combination is not just paddy and brackish shrimp. It includes fresh water shrimp as well. In some areas, fresh-water shrimp and paddy are produced at the same time at the same place. In this system, outer part of the paddy field is dug 1m or deeper than central part of the field. While paddy is planted in the central part of the paddy field, shrimp is cultivated in the deep water of the surrounding part. By combining the two commodities, environment, especially water quality, can be kept better for shrimp culture and the expected profitability can be also higher.

2.2 Agriculture in the Project Area

2.2.1 Salient Features in Agriculture

1) Soil with High Acidity

A total 2.6 million ha, approximately 60% of the Mekong Delta in Vietnam, is recognized as actual and potential acid sulfate soils[10]—widely called as the "plain of reed." In the actual acid sulfate soils, pH level could reach to pH 2.0 to 3.0, which is much lower than the minimum level, pH 4.0, to the growth of paddy[11]. Acidification occurs when the potential soil with "pyrite" is exposed to oxygen during the dry season especially April to June. Once the soil became acidic, it causes acidic pollution in canal water and affects even other areas.

Historically, in such area where acidity is high, Melaleuca, an acid tolerant tree, had been dominant (1.5 million ha) in the Mekong Delta especially in Ca Mau peninsula, Long Xuyen Quadrangle and on the Plain of Reeds[12]. However, Melaleuca forest has decreased from 1.5 million ha to 120,000ha by today. Recently, acid sulfate soils are also used for farming through application of irrigation water for leaching.

Figure 2.2.1 shows the soil classification map of the Mekong Delta including the distribution of acid sulfate soils. According to the map, deep active acid sulfate soils are concentrated in the upper part of

[10] "Acid Sulphate Soils and Cropping Systems, Can Tho university"
http://www.ctu.edu.vn/tropmester/modules/module4.pdf
[11] http://dspace.lib.niigata-u.ac.jp:8080/dspace/bitstream/10191/969/1/18...
[12] http://www.worldagroforestrycentre.org/sea/Products/AFDbases/AF/asp/SpeciesInfo.asp?SpID=18108

the Mekong Delta and less is found in the coastal area.

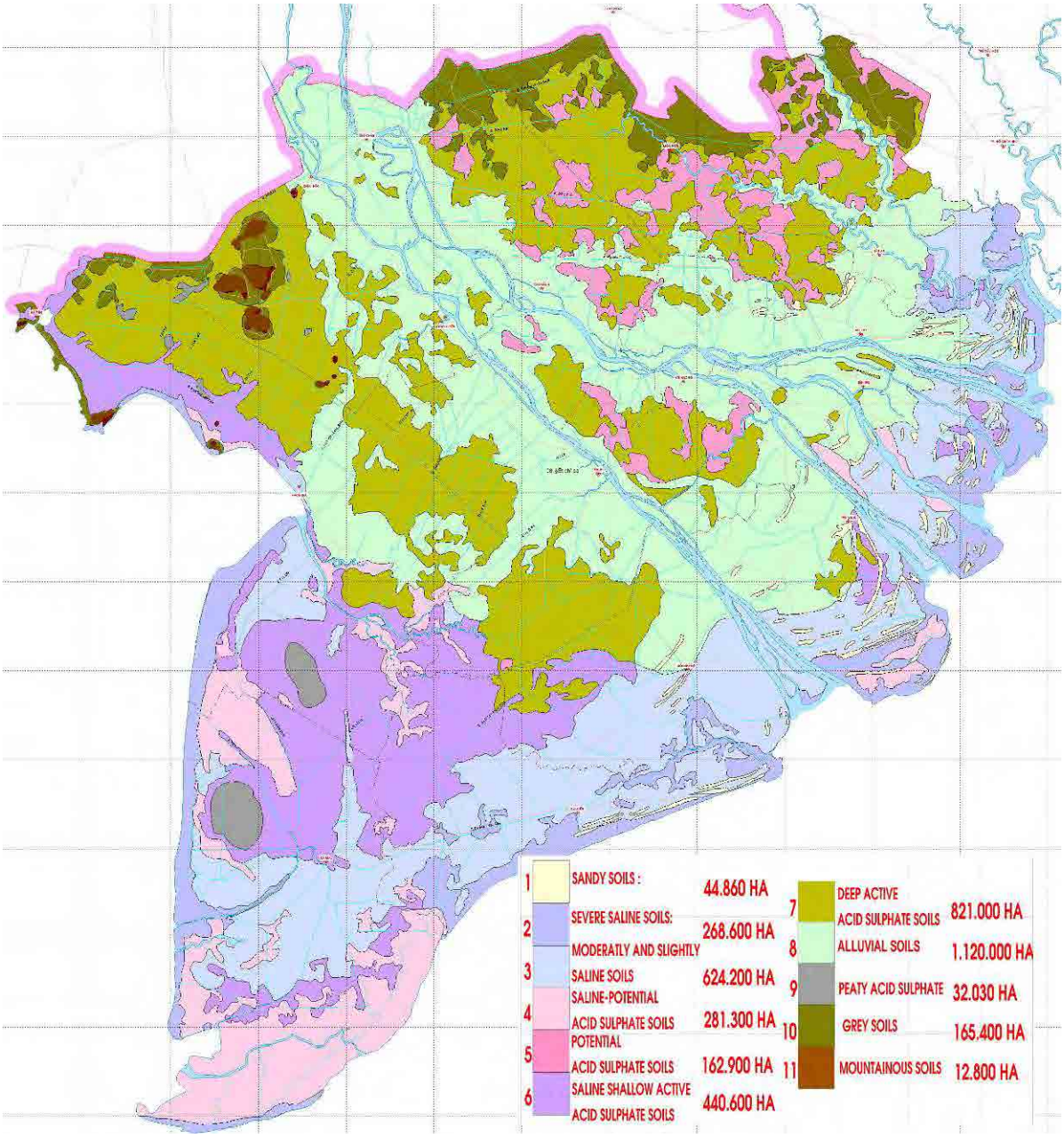


Figure 2.2.1 Soil Classification Map of the Mekong Delta
Source: SIWRP (2011)

2) Soil with High Salinity

As discussed, salinity intrusion characterizes the agro-ecological features of the Mekong Delta. Farming systems in the area is by most account adapted to the distribution of saline water intrusion. As shown in Figure 2.2.2, salinity intrusion is severe in the coastal areas especially in Ca Mau, Bac Lieu, Ben Tre and Tan An provinces. As shown in the figure, it is estimated that 1,343,700 ha are affected by more than 4 g/L of saline water, while 284,100 ha and 242,000 ha are affected by 2 g/L and 1 g/L respectively.

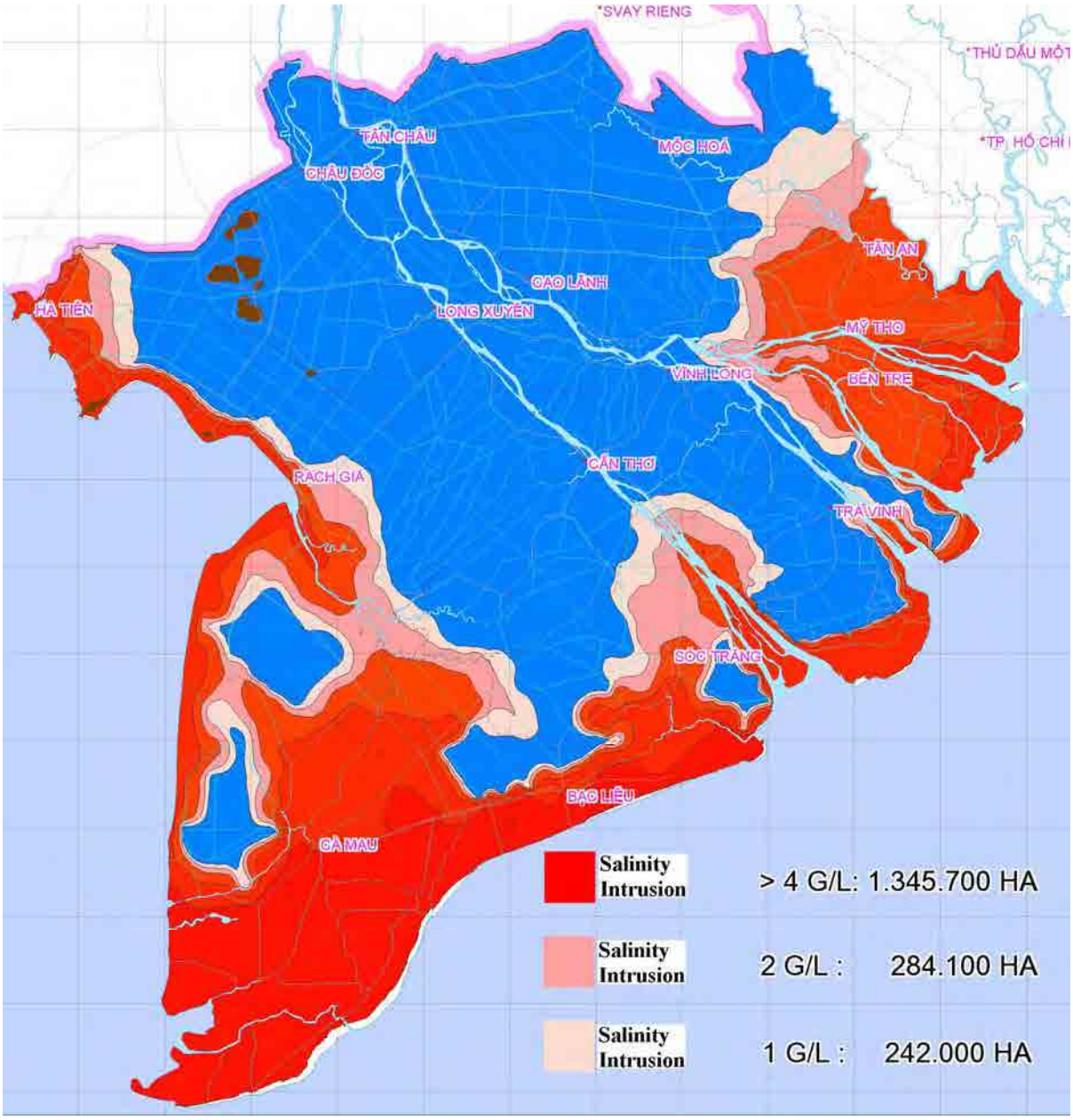


Figure 2.2.2 Saline Intrusion in the Mekong Delta
Source: SIWRP (2011)

2.2.2 Agriculture Land Use

1) Agricultural Land Use

As shown as Figure 2.2.3, land use in the Mekong Delta is quite diverse. By and large, double and triple cropping of paddy is dominant in the upper delta especially along the River, while brackish fishery stretches out along the coastal areas. Those major two patterns of land use are further diversified by the different types of forest areas (protective, productive, reforestation etc.), annual crops, and freshwater fishery (in this classification, shrimp culture is included in “fishery”).

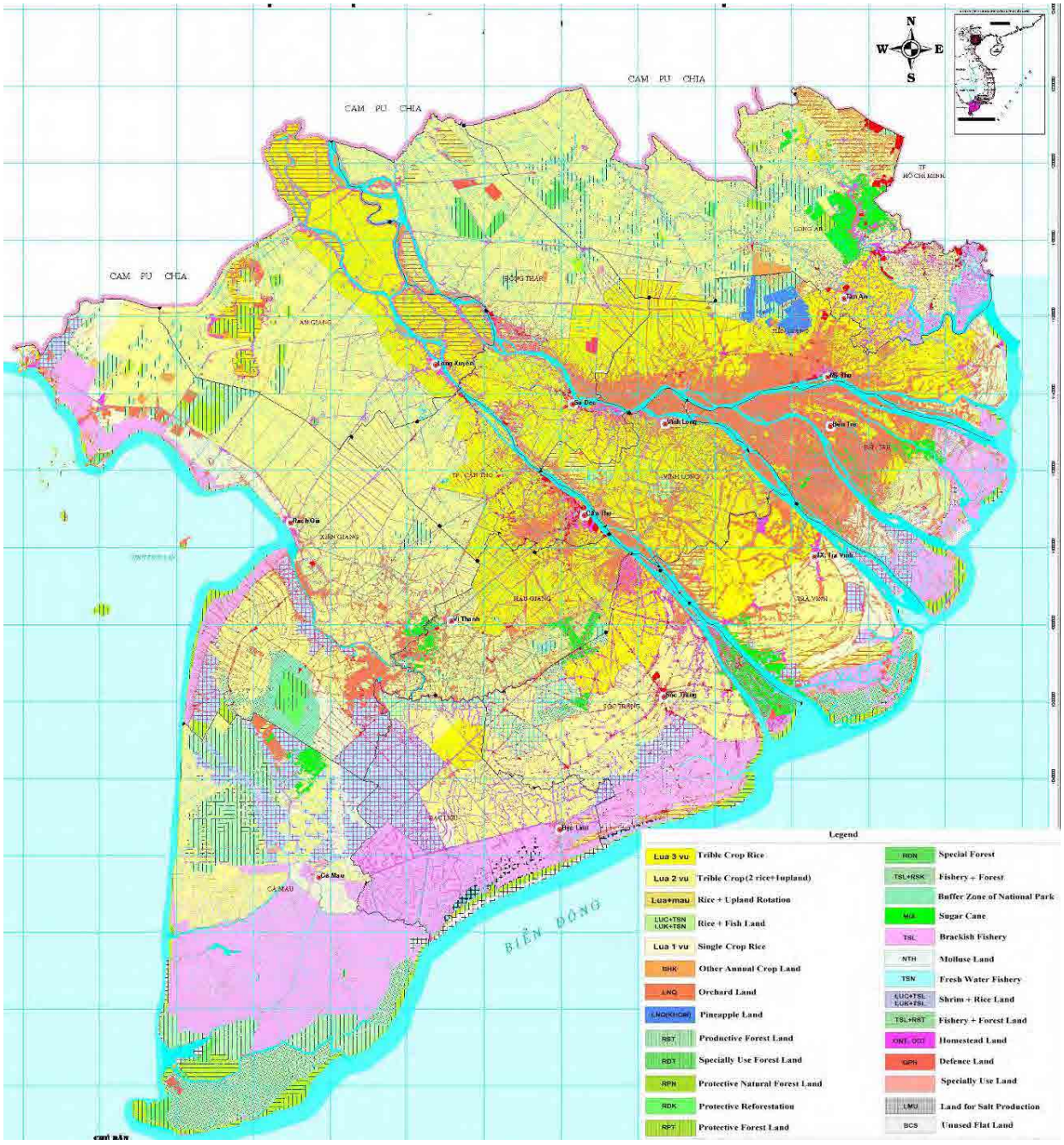


Figure 2.2.3 Land Use Map of the Mekong Delta as of 2008

Source: SIWRP (2011)

Referring to the statistical data, difference of land use types in each province is clarified. As shown in Figure 2.2.4 and Table 2.2.1, ratio of agricultural land use in the Mekong Delta is much higher than other areas of the country. While 63% of the area is used for agricultural purposes in the Mekong Delta, only 29% is used in the whole country, which is far greater than any other regions including the Red River Delta (36%).

Among the provinces in the Mekong Delta, there are also some variations: while the agricultural land use in most of provinces ranges around 50% to 75%, Bac Lieu and Ca Mau, coastal two provinces, resulted in 39% and 27%. It is probably reflects the large aquacultural area in those two provinces.

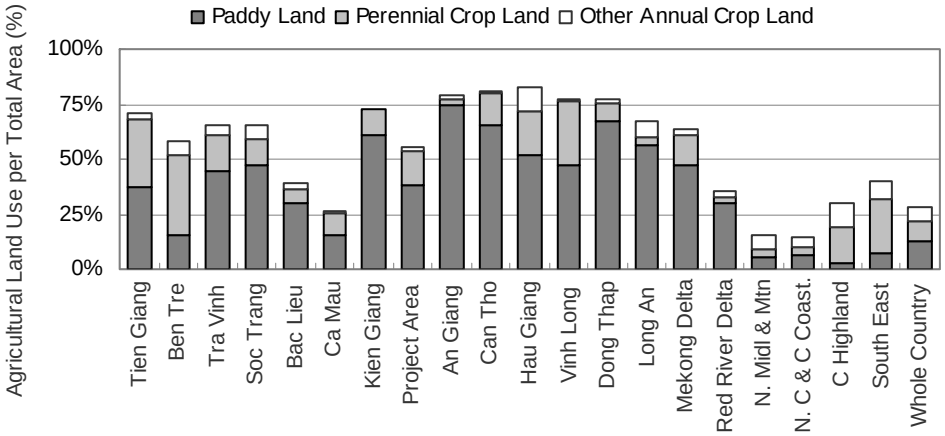


Figure 2.2.4 Agricultural Land Use per Total Land Area (%))

Source: Rural, Agricultural and Fishery Census, Data in 2006

Looking at the percentage of land uses in paddy, perennial crops and other annual crops per agricultural land of each province, there are also some geographical differences. As shown in Figure 2.2.5, percentage of paddy in the whole Mekong Delta (75%) is first of all higher than that of whole country (44%), which is after the Red River Delta (83%). Among the provinces of the project area, Kien Gian (83%) was the highest, which was followed by Bac Lieu (75%) and Soc Trang (73%). On the other hand, paddy area of Ben Tre (23%) was quite limited, suggesting that the most of agricultural area in Ben Tre province is not suited to paddy production but perennial crops.

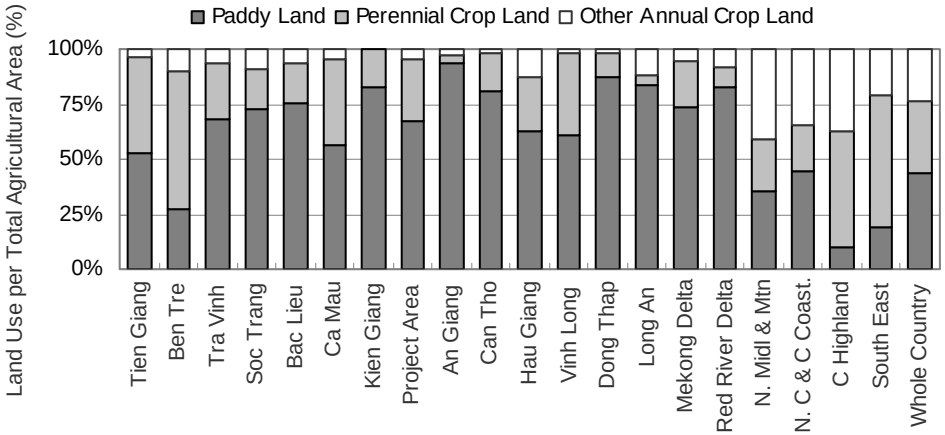


Figure 2.2.5 Agricultural Land Use per Total Agricultural Area (%)

Source: Rural, Agricultural and Fishery Census, Data in 2006

Table 2.2.1 Agricultural Land Use in the Project Area

Province/ Region	Agricultural Production Land					Ratio of Agricultural Land per Total Land Area						Ratio per Agricultural Land Area			
	Total, '000ha, *2	Total Annual Crop Land	Paddy Land	Other Annual Crop Land	Perennial Crop Land	Total Land Area	Total Agricultral Area	Annual Crop Land	Paddy Land	Other Annual Crop Land	Perennial Crop Land	Annual Crop Land	Paddy Land	Other Annual Crop Land	Perennial Crop Land
	000ha	000ha	000ha	000ha	000ha	(km2)	%	%	%	%	%	%	%	%	%
Tien Giang	176.05	98.94	92.97	5.97	77.11	2,484	71%	40%	37%	2%	31%	56%	53%	3%	44%
Ben Tre	136.68	50.90	37.50	13.40	85.78	2,360	58%	22%	16%	6%	36%	37%	27%	10%	63%
Tra Vinh	150.77	112.67	102.63	10.04	38.10	2,295	66%	49%	45%	4%	17%	75%	68%	7%	25%
Soc Trang	216.53	177.09	157.29	19.80	39.44	3,312	65%	53%	47%	6%	12%	82%	73%	9%	18%
Bac Lieu	98.20	80.11	73.92	6.19	18.09	2,502	39%	32%	30%	2%	7%	82%	75%	6%	18%
Ca Mau	142.05	87.11	80.66	6.45	54.94	5,332	27%	16%	15%	1%	10%	61%	57%	5%	39%
Kien Giang	441.34	365.76	358.50	7.26	75.58	6,346	70%	58%	56%	1%	12%	83%	81%	2%	17%
Project Area	1,361.62	972.58	903.47	69.11	389.04	24,631	55%	39%	37%	3%	16%	71%	66%	5%	29%
An Giang	280.65	271.39	263.09	8.30	9.26	3,537	79%	77%	74%	2%	3%	97%	94%	3%	3%
Can Tho	113.68	94.15	92.25	1.90	19.53	1,402	81%	67%	66%	1%	14%	83%	81%	2%	17%
Hau Giang	132.41	99.83	83.05	16.78	32.58	1,601	83%	62%	52%	10%	20%	75%	63%	13%	25%
Vinh Long	114.67	71.70	69.83	1.87	42.97	1,479	78%	48%	47%	1%	29%	63%	61%	2%	37%
Dong Thap	259.97	232.84	227.45	5.39	27.13	3,375	77%	69%	67%	2%	8%	90%	87%	2%	10%
Long An	304.25	289.35	254.33	35.02	14.90	4,494	68%	64%	57%	8%	3%	95%	84%	12%	5%
Mekong Delta	2,567.25	2,031.84	1,893.47	138.37	535.41	40,519	63%	50%	47%	3%	13%	79%	74%	5%	21%
Red River Delta	756.26	684.03	623.38	60.65	72.23	21,063	36%	32%	30%	3%	3%	90%	82%	8%	10%
N. Midl & Mtn	1,485.99	1,136.43	524.50	611.93	349.56	95,339	16%	12%	6%	6%	4%	76%	35%	41%	24%
N. C & C Coast.	1,402.55	1,108.41	628.12	480.29	294.14	95,885	15%	12%	7%	5%	3%	79%	45%	34%	21%
C Highland	1,615.92	756.90	160.74	596.16	859.02	54,641	30%	14%	3%	11%	16%	47%	10%	37%	53%
South East	1,608.17	630.54	300.73	329.81	977.63	40,519	40%	16%	7%	8%	24%	39%	19%	21%	61%
Whole Country	9,436.14	6,348.15	4,130.94	2,217.21	3,087.99	331,051	29%	19%	12%	7%	9%	67%	44%	23%	33%

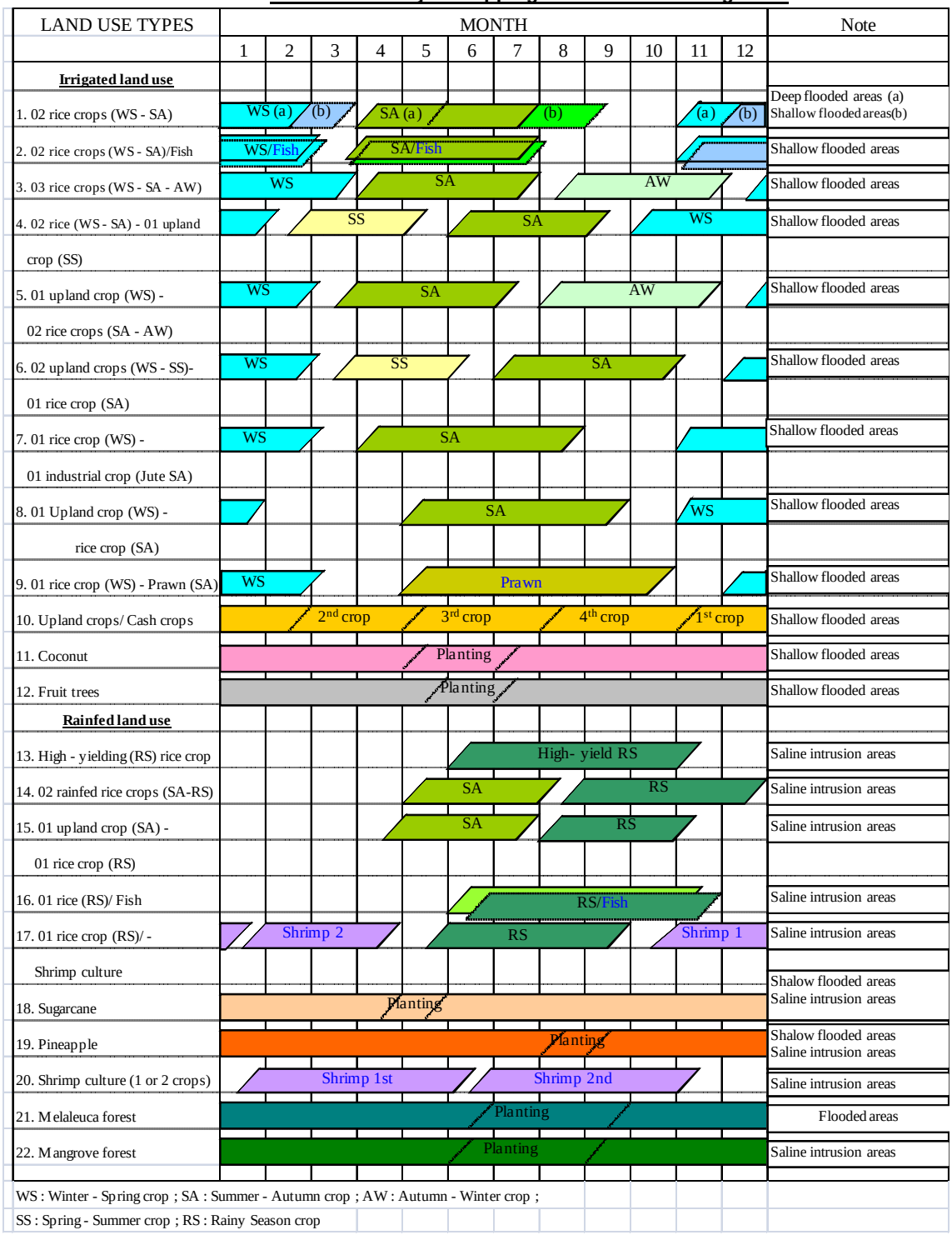
*1: The 2009 Vietnam Population and Housing Census

*2: Rural, Agricultural and Fishery Census, Data in 2006

2) Cropping Calendar

Cropping systems in the Mekong Delta are quite diverse and highly sophisticated. As shown in Table 2.2.2, there are several combinations of various crops including, paddy, upland crops, and aquaculture. As of the cropping calendar of paddy, there are four major seasons: winter-spring, summer-autumn, autumn-winter and spring-summer in an order of popularity in terms of planted areas. Among the four cropping seasons, winter-spring paddy (Dec-Feb) and summer-autumn (May-Aug) paddy constitute the major part of paddy production in the area.

Table 2.2.2 Major Cropping Calendar in Mekong Delta



Source: Southern Institute of Agricultural Planning and Investment (2011)

Paddy production is organized with various combinations in accordance with the availabilities of irrigation water, fresh water and schedule of other crops or commodities. For example, two cropping of winter-spring paddy and summer-autumn paddy are organized where irrigation water is available. In some cases, three cropping of paddy can be also possible.

In rainfed areas where irrigation is barely available, paddy is planted only during the rainy season, in which summer-autumn and autumn-winter paddies are organized. In such areas where salinity intrusion takes place along the coastal areas, in addition, rainfed paddy production is often combined with shrimp culture. Surprisingly, in dry season, paddy field is filled with saline water for shrimp culture and then after a certain time for leaching of salinity by fresh water, paddy is planted in the same plot.

Salinity is usually seen as a harmful feature to paddy production and it is often prevented by dikes and gates. Yet, some farmers have chosen the way to adapt to this kind of extreme environment rather than protecting it. As a result, those farmers can maximize its profitability in paddy-shrimp combination.

2.2.3 Agriculture Production in Mekong Delta

Production of cereals in Mekong Delta is shown in Table 2.2.3. It has been on an increasing trend and in 2010 the total production reached 21,769,500 tons in the Mekong delta total. Looking at the provincial production of 2010, An Giang shares 17%, which is followed by Kien Giang (16%) and Dong Thap (13%). On the other hand, coastal provinces have relatively less production. For example, Ben Tre, Tra Vinh, Bac Lieu and Ca Mau share only 2%, 5%, 4% and 2% of the area respectively, which is in line with the land use pattern illustrated in Figure 2.2.3.

Table 2.2.3 Production of Cereals by Province

Thousand ton

Year	2005	2007	2008	2009	2010	%
Long An	1,948.7	1,977.2	2,205.7	2,178.1	2,304.3	11%
Tien Giang	1,314.0	1,320.1	1,336.5	1,323.6	1,332.8	6%
Ben Tre	344.3	307.1	363.2	365.8	370.8	2%
Tra Vinh	1,052.1	953.6	1,115.4	1,102.8	1,182.7	5%
Vinh Lomg	974.5	812.8	898.3	913.9	925.8	4%
Dong Thap	2,642.3	2,576.8	2,759.0	2,681.5	2,808.1	13%
An Giang	3,218.4	3,223.0	3,599.4	3,486.6	3,760.8	17%
Kien Giang	2,944.3	2,977.3	3,387.3	3,397.9	3,485.3	16%
Can Tho	1,237.7	1,136.0	1,203.5	1,143.2	1,194.6	5%
Hau Giang	1,117.0	872.8	1,029.1	1,003.5	1,096.3	5%
Soc Trang	1,643.7	1,612.1	1,752.9	1,795.3	1,953.3	9%
Bac Lieu	663.6	694.1	765.1	821.0	849.8	4%
Ca Mau	387.6	419.7	483.3	504.2	504.9	2%
Total	19,488.2	18,882.6	20,898.7	20,717.4	21,769.5	100%

Source: Statistical Yearbook of Vietnam (2010)

Furthermore, Table 2.2.4 shows production of cereals per capita. As shown in the table, the most productive province in 2010 was Kien Giang, 2,046 kg/capita or 162% of the average, while the least productive province was found Ben Tre with 295kg/capita or 23% of the average. This quite low figure, including Ca Mau (33%), implies the damage from salinity intrusion in these provinces.

Table 2.2.4 Production of Cereals per Capita by Province kg/capita

Year	2005	2007	2008	2009	2010	%
Long An	1,398.5	1,394.5	1,544.4	1,516.5	1,593.3	126%
Tien Giang	796.3	794.5	801.3	791.2	794.8	63%
Ben Tre	270.4	242.8	288.3	291.2	295.1	23%
Tra Vinh	1,062.5	956.3	1,114.5	1,099.3	1,175.8	93%
Vinh Lomg	955.2	794.7	877.2	891.5	901.9	72%
Dong Thap	1,611.6	1,557.4	1,659.5	1,609.0	1,681.0	133%
An Giang	1,519.5	1,510.1	1,679.9	1,623.5	1,749.6	139%
Kien Giang	1,817.7	1,799.1	2,025.5	2,012.4	2,046.0	162%
Can Tho	1,077.2	969.3	1,019.1	961.8	997.9	79%
Hau Giang	1,486.4	1,156.5	1,360.7	1,323.9	1,445.2	115%
Soc Trang	1,306.0	1,263.1	1,364.0	1,388.3	1,501.6	119%
Bac Lieu	816.4	830.5	902.8	958.2	979.3	78%
Ca Mau	327.7	351.2	402.2	417.7	416.5	33%
Average	1,155.9	1,108.0	1,220.0	1,204.5	1,260.4	100%

Source: Statistical Yearbook of Vietnam (2010)

More detailed statistical data on paddy production by season are available, as shown in Figure 2.2.6, production of paddy is in an increasing trend, notwithstanding some stagnation in area planted. In particular, summer-autumn production and winter-spring production have been increasing in the past two decades, while the production of autumn-winter paddy is in a decreasing trend. General trend of increase in production is probably attributed mainly to the introduction of improved varieties and increase in the use of chemical fertilizer. A series of interview made to some farmers revealed that about 200-400 kg/ha of chemical fertilizer is being applied in the area, which is quite a high level of application in accordance with the available standard of the Philippines for example[13].

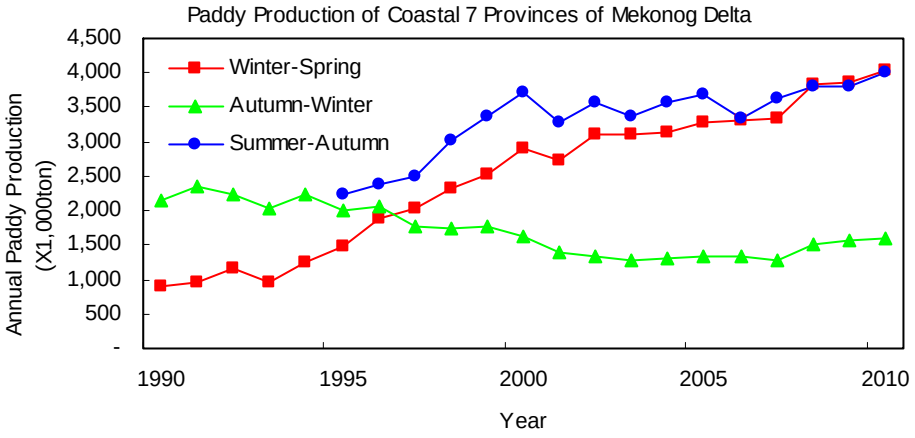


Figure 2.2.6 Paddy Production in Coastal Seven Provinces

Source: Statistical Yellow Book of Vietnam (2011)

Figure 2.2.7 shows the yield of paddy for three different seasonal categories. As all the three categories shows basically increasing trends in the pat two decades. Especially spring paddy has kept the highest yield as compared to other two categories, which recorded 6.4 ton/ha in 2010 as an average of seven provinces. Looking at each provinces, An Giang province recorded 7.3 ton/ha in 2010.

[13] In the Philippines, it is recommended to apply 275 to 300kg/ha of chemical fertilizer to achieve 5-6 ton/ha (Quick guide for fertilizing transplanted rice in Laguna, DA, PhiRice, OPAg, IRRI, May, 2009).

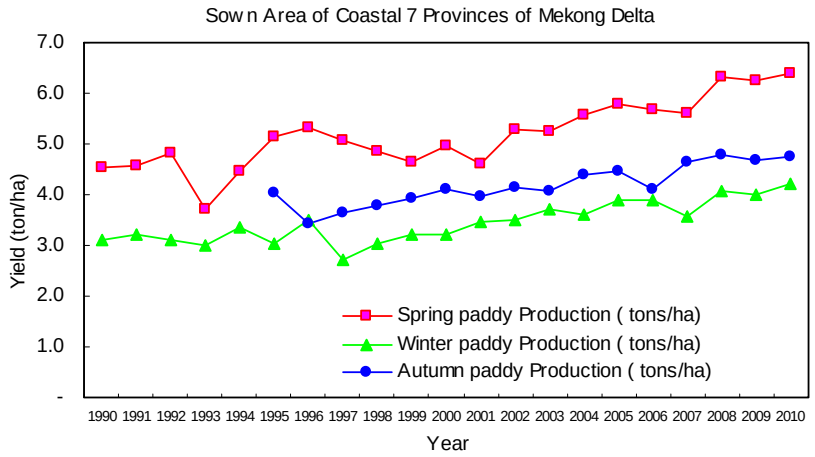


Figure 2.2.7 Yield of Paddy in the Project Area

Source: Statistical Yellow Book of Vietnam (2011)

Table 2.2.5 Yield of Paddy from 2000 to 2010

Cropping Season	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Ave.
Spring paddy Production												
Mekong Delta	5.3	5.0	5.7	5.7	5.9	6.1	6.0	6.0	6.4	6.4	6.6	5.9
Project Area	5.0	4.6	5.3	5.3	5.6	5.8	5.7	5.6	6.3	6.3	6.4	5.6
Winter paddy Production												
Mekong Delta	3.1	3.4	3.4	3.6	3.6	3.8	3.8	3.5	4.0	3.9	4.2	3.6
Project Area	3.2	3.5	3.5	3.7	3.6	3.9	3.9	3.6	4.1	4.0	4.2	3.7
Autumn paddy Production												
Mekong Delta	3.7	3.7	4.0	4.0	4.4	4.5	4.1	4.6	4.8	4.7	4.8	4.3
Project Area	4.1	4.0	4.2	4.1	4.4	4.5	4.1	4.6	4.8	4.7	4.7	4.4
All												
Mekong Delta	3.7	3.7	4.0	4.0	4.4	4.5	4.1	4.6	4.8	4.7	4.8	4.9
Project Area	4.1	4.0	4.2	4.1	4.4	4.5	4.1	4.6	4.8	4.7	4.7	4.6

Source: Statistical Yellow Book of Vietnam (2011)

CHAPTER 3 AGRICULTURE AND AQUACULTURE HOUSEHOLD SURVEY

3.1 Outline of the Survey

In the Project, questionnaire household survey had been organized from November 11 to 17, 2011, through which a total of 211 households have been interviewed in accordance with a pre-structured questionnaire form that address 11 major issues: 1) family structure, 2) physical structure of farm plot, 3) type of water sources, 4) cropping pattern, 5) paddy production, 6) shrimp production, 7) fruits production, 8) livestock production, 9) aquaculture production, 10) agricultural technology, 11) peoples' reality on climate change.

First of all, a total of six villages (communes) were selected from a total of five provinces: Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, and Ca Mau provinces. Those villages were selected in a plenary session of the workshop held on October 27, 2011 at the Southern Institute for Water Resources and Planning (SIWRP), Ho Chi Minh City, based primarily on the criteria that were to select major production areas of paddy, fruits, and shrimp without major successive problems. The participants of the workshop were the representatives of Provincial Peoples' Committee (PPC) and Department of Agriculture and Rural Development (DARD) of seven provinces in the Project Area.

The surveyed areas are summarized in Table 3.1.1. As shrimp production areas, Soc Trang and Ca Mau provinces have been covered. As paddy production area BeTre and Tra Vinh provinces were addressed. And, as fruit production area, Ben Tre province was selected. In fact, two villages were selected in Ben Tre province, one for paddy production area and other for fruits production area. Bac Lieu province was seen as shrimp production and area for the combination of shrimp-paddy production. Location of each commune is shown in Figure 3.1.1 and specific characteristics of the land use surrounding the surveyed communes are also illustrated as Figure 3.1.2. In this report, names of district, not the communes, are used for the explanation of the results.

Table 3.1.1 Surveyed Area and Number of Survey Samples by District

Province	District	Commune	No. of Samples	Major Feature	Date of Interview	Sample ID
Ben Tre	Ba Tri	An Binh Tay	38	Paddy	Nov.11	1-38
Ben Tre	Giong Trom	Thuan Dien	42	Fruits	Nov.10	39-80
Tra Vinh	Cang Long	Huyen Hoi	30	Paddy	Nov.12	81-110
Soc Trang	Vinh Chau	Vinh Hai	21	Shrimp	Nov.17	111-132
Bac Lieu	Phuoc Long	Phuoc Long	41	Shrimp/ Shrimp-Paddy	Nov.16	133-173
Ca Mau	Cai Nuoc	Tran Thoi	39	Shrimp	Nov.15	174-212
Total			211			

Source: Questionnaire Household Survey, JICA Project Team (2012)

In the questionnaire survey, a survey team was constituted with 11 surveyors including a team leader. Then, the team visited each and single commune day by day, having interview to a group of farmer households usually at the PPCs office altogether. The total number of samples taken through the survey was originally 212 samples but one sample was eliminated from the group of Vinh Chau as it contained extreme data, to be 211 samples analyzed.

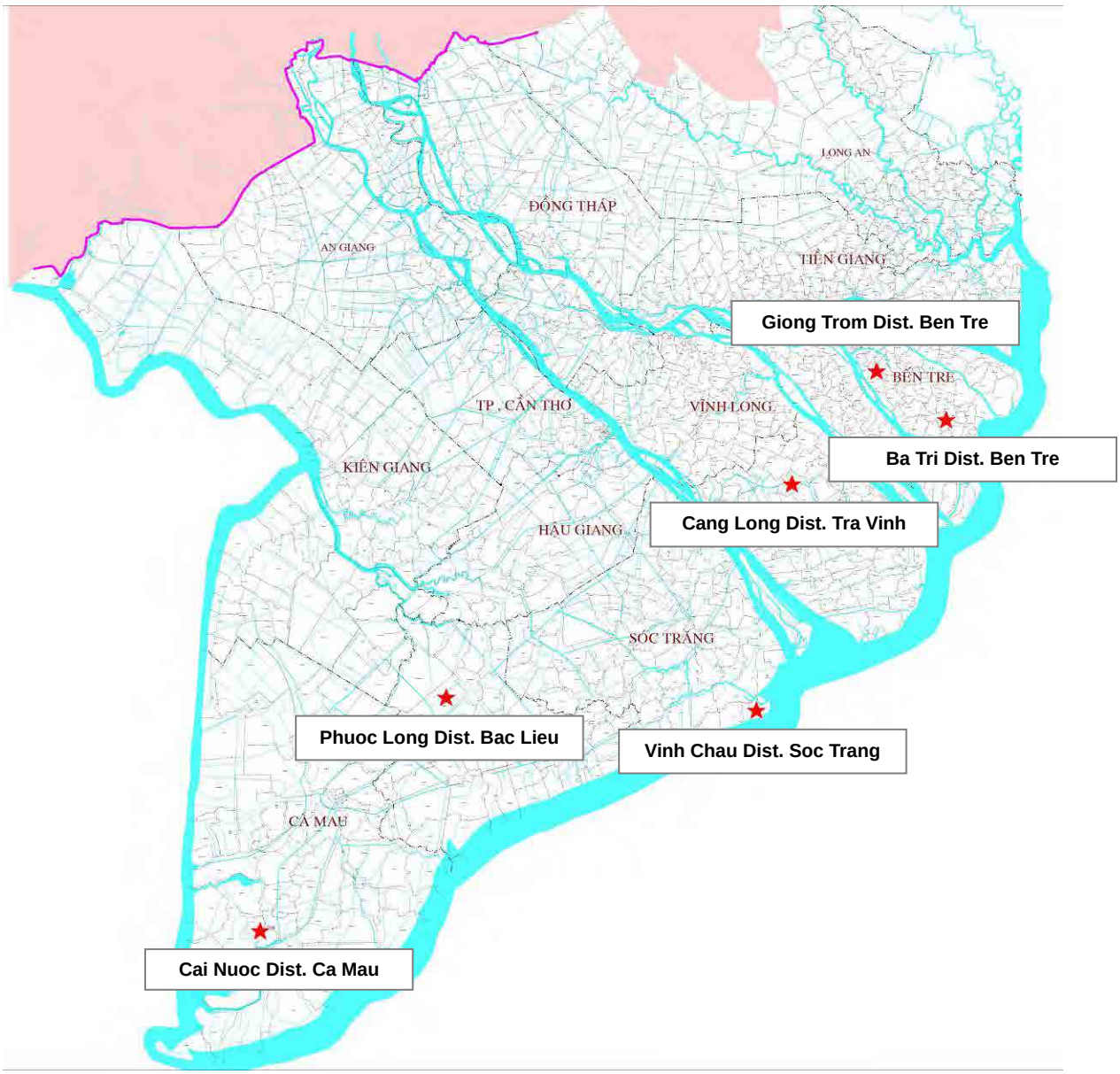
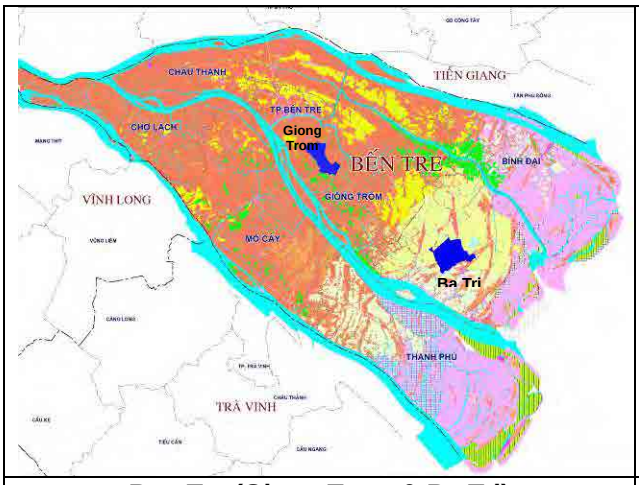
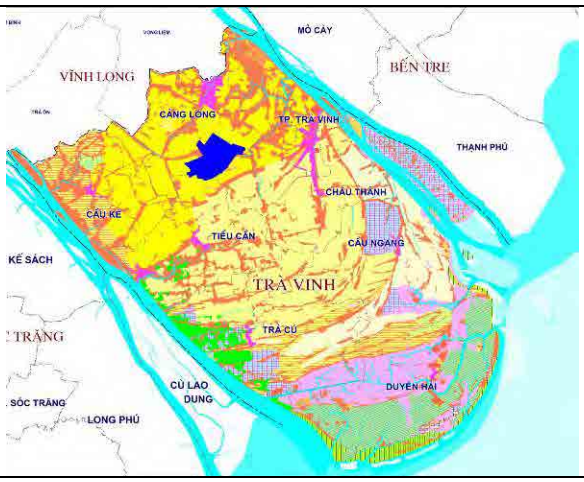


Figure 3.1.1 Location Map of Household Questionnaire Survey (Whole)

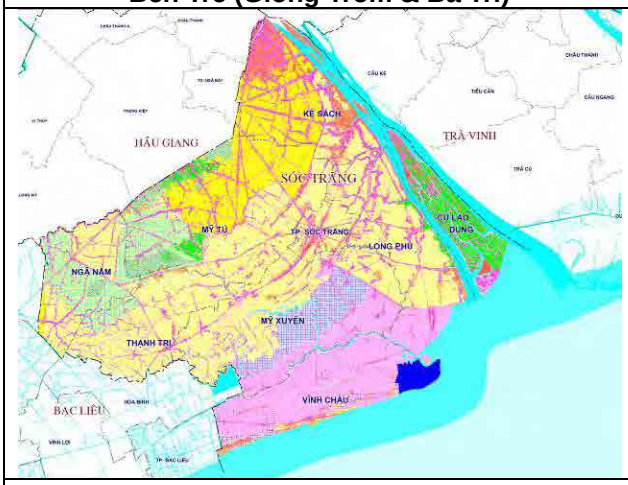
Source: Questionnaire Household Survey, JICA Project Team (2012)



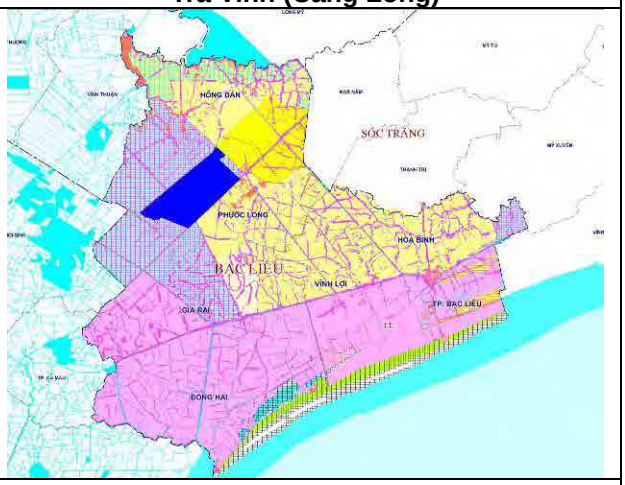
Ben Tre (Giong Trom & Ba Tri)



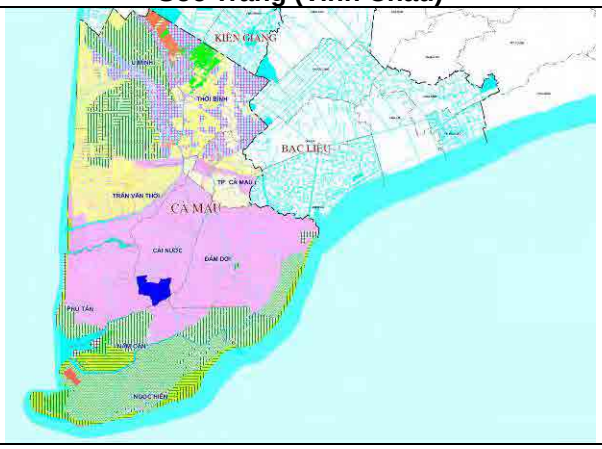
Tra Vinh (Cang Long)



Soc Trang (Vinh Chau)



Bac Lieu (Phoc Long)



Ca Mau (Cai Nuoc)

Lua 3 vu	Trible Crop Rice	RDN	Special Forest
Lua 2 vu	Trible Crop(2 rice+1upland)	TSL+RSK	Fishery + Forest
Lua+mau	Rice + Upland Rotation		Buffer Zone of National Park
LUC+TSN LUK+TSN	Rice + Fish Land	MIA	Sugar Cane
Lua 1 vu	Single Crop Rice	TSL	Brackish Fishery
BHK	Other Annual Crop Land	NTH	Molluse Land
LNQ	Orchard Land	TSN	Fresh Water Fishery
LNQ(KHOM)	Pineapple Land	LUC+TSL LUK+TSL	Shrim + Rice Land
RST	Productive Forest Land	TSL+RST	Fishery + Forest Land
RDT	Specially Use Forest Land	ONT, ODT	Homestead Land
RPN	Protective Natural Forest Land	QPH	Defence Land
RDK	Protective Reforestation		Specially Use Land
RPT	Protective Forest Land	LMU	Land for Salt Production
		BCS	Unused Flat Land

Figure 3.1.2 Land Use of Surveyed Provinces

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Targeted communes are painted by blue color.

3.2 Family Structure of the Sample Households

1) Number of Family Members

An average numbers of family members per household were 4.6 persons for the all districts surveyed. It varies from 3.1 persons per household of Giong Trom district (Ben Tre) to 5.3 persons of Cai Nuoc district (Ca Mau). As shown in Figure 3.2.1, the most frequent number of family members per household for the entire samples was found 4 persons, which accounts for 33% of the samples (Table 3.2.2). The second and third most frequent were 5 and 3 persons respectively.

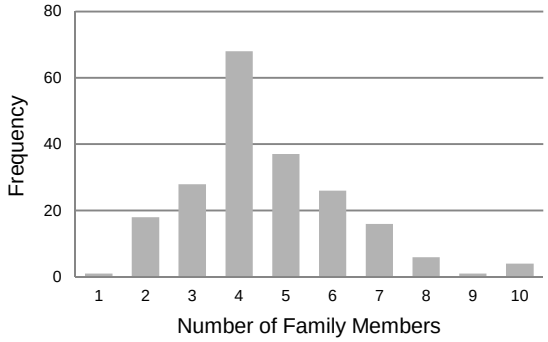


Figure 3.2.1 Number of Sample Household by Number of Family Member
Source: Questionnaire Household Survey, JICA Project Team (2012)

Comparing to the provincial statistics, results of questionnaire survey are slightly higher. For example, an average of six surveyed districts (4.6 persons/ household) is larger than average of project area (4.0), Mekong Delta (4.0) or whole country (3.9). It was only Giong Trom that marked smaller number of family member than the average of its province (3.1).

Table 3.2.1 Average Number of Family Member per Household

District	No. of Family Members	Province/ Region	Rural HH Members
Ba Tri	4.7	Ben Tre	3.5
Giong Trom	3.1		
Cai Nuoc	5.3	Ca Mau	4.3
Cang Long	4.4	Tra Vinh	4.0
Phuoc Long	5.1	Bac Lieu	4.5
Vinh Chau	5.1	Soc Trang	4.2
Average	**4.6**	**Project Area**	**4.0**
		Mekong Delta	**4.0**
		Whole Country	**3.9**

Source: Questionnaire Household Survey, JICA Project Team (2012) (Left)/
The 2009 Vietnam Population and Housing Census (right)

Table 3.2.2 also shows the difference of family structure among the districts surveyed. For example, the most frequent number of family members per household was only two (13 respondents) in Giong Trom district (Ben Tre), implying that the majority of the households were nuclear families. Considering the average size of farm plot per household (1.57 ha, see section 3.4), labor for farming can easily get scarce whereby those families need to hire labors, mechanize the farming system or keep the system far extensive. In fact, the use of machinery or outsourcing of labor works is already common in this area (Table 3.5.17).

Table 3.2.2 Frequency for the Number of Family Member by District

Numer of Family Members	Ba Tri	Cai Nuoc	Cang Long	Giong Trom	Phuoc Long	Vinh Chau	Total	%
1					1		1	0%
2			4	13	1		18	9%
3	3	4	2	12	4	3	28	14%
4	18	11	11	7	13	8	68	33%
5	10	10	7	4	4	2	37	18%
6	4	5	4		9	4	26	13%
7	1	4	2		7	2	16	8%
8	2	3			1		6	3%
9						1	1	0%
10		2			1	1	4	2%
Total	**38**	**39**	**30**	**36**	**41**	**21**	**205**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

3.3 Water Sources for Agriculture and Aquaculture

1) Type of Water Sources

Table 3.3.1 to Table 3.3.3 shows the types of water sources for paddy cultivation and shrimp culture in rainy and dry season. Based on a multiple answering question, the number of valid responses for paddy cultivation was 95 for rainy season and 84 for dry season. In rainy season, 60 responses (63%) were given to "rain water," which was followed by groundwater (28 responses, 29%). While rain water is the major source of water, groundwater is also used as supplemental water source during rainy season. On the other hand, the percentage of groundwater was the majority (63%) in dry season. Still, 26% of the respondents use rain water due probably to occasional rain.

For shrimp culture, percentage of groundwater is the greatest both for rainy season (59%) and dry season (73%). In shrimp culture, especially intensive ones, careful management of water quality is required and thus majority of shrimp farmers usually have wells. In both seasons, to be sure, rain water is also used as a secondary water source.

There are a total of 30 and 26 valid responses in shrimp-paddy farming for rainy and dry seasons respectively. Similar to shrimp culture, the major water source in shrimp-paddy farming is ground water (60% in rainy season and 65% in dry season), although the number of valid responses is limited. It is considered that the installation of well is one prerequisite to start shrimp culture regardless if it is mono culture or combination with paddy cultivation.

To make sure, there was no significant difference of those trends by district; almost all districts followed the trend: rain water for paddy cultivation in rainy season and ground water for shrimp culture and paddy cultivation in dry season.

Table 3.3.1 Types of Water Sources for Paddy Farmers

District	Rainy Season					Dry Season				
	Rain Water	Canal Water	River Water	Ground Water	Total	Rain Water	Canal Water	River Water	Ground Water	Total
Ba Tri	32	1		9	42	11	3	2	29	45
Cang Long	25	5	1	17	48	11	4		22	37
Phuoc Long	3			2	5				2	2
Total	**60**	**6**	**1**	**28**	**95**	**22**	**7**	**2**	**53**	**84**
	63%	**6%**	**1%**	**29%**	**100%**	**26%**	**8%**	**2%**	**63%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Table 3.3.2 Types of Water Sources for Shrimp Farmers

District	Rainy Season					Dry Season				
	Rain Water	Canal Water	River Water	Ground Water	Total	Rain Water	Canal Water	River Water	Ground Water	Total
Cai Nuoc	24		4	32	60	13		4	34	51
Phuoc Long	4			7	11				7	7
Vinh Chau	4	1	3	19	27	1	1	3	19	24
Total	**32**	**1**	**7**	**58**	**98**	**14**	**1**	**7**	**60**	**82**
	33%	**1%**	**7%**	**59%**	**100%**	**17%**	**1%**	**9%**	**73%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Table 3.3.3 Types of Water Sources for Paddy-Shrimp Farmers

District	Rainy Season					Dry Season				
	Rain Water	Canal Water	River Water	Ground Water	Total	Rain Water	Canal Water	River Water	Ground Water	Total
Phuoc Long	5	2	5	16	28	3	2	4	15	24
Vinh Chau				2	2				2	2
Total	**5**	**2**	**5**	**18**	**30**	**3**	**2**	**4**	**17**	**26**
	17%	**7%**	**17%**	**60%**	**100%**	**12%**	**8%**	**15%**	**65%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- For paddy cultivation, the use of rain water is common (63%) in rainy season, while groundwater is the majority (63%) in dry season.
- The use of groundwater is common in shrimp culture both for rainy season (59%) and dry season (73%), suggesting well is a required condition to start shrimp culture.
- For shrimp-paddy farming, tendency is same as shrimp culture; groundwater is the major water source both for rainy and dry season.
- As of the tendency, there is not much difference among districts surveyed.

2) Depth of Wells

As of the depth of wells, significant differences were found among the districts surveyed: while Ba Tri (Ben Tre) and Giong Trom (Ben Tre) have relatively shallower wells, averaging 6 m each, other districts maintain relatively deeper wells more than 100 m in depth as an average of each district. Geographic condition of the area probably influenced the result, but the clear evidence is yet found.

As the whole, the deepest well is 220 m in Cai Nuoc (Ca Mau), while the shallowest well is 2 m in Ba Tri (Ben Tre) to be 89m on an average of all the samples (157 valid responses). Except Ben Tre province, farmers are, for some reason, required to dig deep wells for agriculture and aquaculture, which is associated with high investment cost both for digging and pumping. Depths of the wells clarified through the questionnaire survey are summarized in Table 3.3.4 by max, min and average.

Table 3.3.4 Depth of Wells (Max, Min and Ave)

District	Depth of Wells (m)			
	Maximum	Minimum	Average	No. of Responses
Ba Tri	30	2	6	29
Cai Nuoc	220	80	128	38
Cang Long	180	48	100	25
Giong Trom	10	5	6	6
Phuoc Long	150	87	110	39
Vinh Chau	129	57	104	20
Total/Average	**220**	**2**	**89**	**157**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Average depth of the wells is 89m ranging from 2m to 220m.
- Ba Tri and Giong Trom (Ben Tre) have shallow wells (6m each), while other districts have deep wells (100m or more).

3) Number of Wells Constructed by Year

Figure 3.3.1 shows the yearly trend in the number of wells constructed for the sampled households. Based on a total of 154 valid responses, it is clearly shown that the number of wells constructed had gradually increased since the end of the war (1975) up until 2001 (19 wells), although there are stagnant period during the late 1990's. Then, the number of well construction had tuned into a decreasing mode since 2002.

There might be two major scenarios to this entire trend: 1) necessary wells had been already constructed by the early 2000's and a fewer constructions of new wells are required; and 2) alternative water sources such as irrigation systems became available since the early 2000's whereby no more construction of wells had been required. As shown in Table 3.3.1 to Table 3.3.3, however, use of canal water is still limited and therefore, alternative water source may not be a major reason.

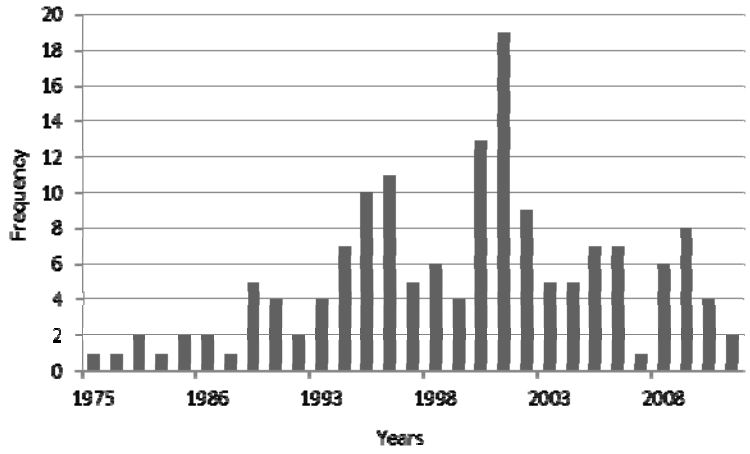


Figure 3.3.1 Number of Wells Constructed
Source: Questionnaire Household Survey, JICA Project Team (2012)

The primary data for the number of wells constructed in each year are shown in Table 3.3.5. It shows that the total number of wells constructed by today is relatively few in Gion Trom (Ben Tre); it is six, while the other districts demonstrate 20 to 39. Probably, hydro-geographical condition of the area is not suited to well, other water sources are available, or fresh water is not so much required for the types of commodities (ex. shrimp) in the area.

Table 3.3.5 Number of Wells Constructed by Year

Year	Ba Tri	Cai Nuoc	Cang Long	Giong Trom	Phuoc Long	Vinh Chau	Grand Total
1975	1						1
1978		1					1
1981	1		1				2
1982		1					1
1985					1	1	2
1986	2						2
1989			1				1
1990		3	1		1		5
1991					2	2	4
1992			2				2
1993		1	1	1	1		4
1994	1	2	1	1	1	1	7
1995	2	4	3		1		10
1996		3	4	1	2	1	11
1997	2	1	1		1		5
1998		5	1				6
1999		2	1			1	4
2000	5	3			3	2	13
2001	2	4	4		8	1	19
2002		3			3	3	9
2003	1		1		2	1	5
2004		1	1		1	2	5
2005	1	2	1		2	1	7
2006	2			1	1	3	7
2007					1		1
2008	3				3		6
2009	4			1	2	1	8
2010	2			1	1		4
2011					2		2
Total	**29**	**36**	**24**	**6**	**39**	**20**	**154**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- The number of wells constructed had increased by the early 2000's and then decreased.
- There are a relatively fewer number of wells in Gion Trom (Ben Tre).

4) Water Quality of Wells

Water quality of wells is a major factor that influence the agricultural and aquacultural practice as well as the decision making process whether wells should be constructed in the area. Figure 3.3.2and Table 3.3.6 shows the issues on water quality of wells drawn from the respondents. Of a total of 149 valid responses, 100 (67%) were given to "good/normal" and 8 (5%) were to "medium/fair/good enough," suggesting approximately 70% of the respondents are satisfied with the current water quality.

However, there were some negative issues pointed out: "alum water[14]" (13 responses, 9%), "saline/ brackish" (10 responses, 7%) and "saline and alum" (6 responses, 4%), which were followed by some issues of bad smells. Reportedly, "alum water" is practically recognized at household level with a change in color of laundries and in texture of those clothes to be rough. Thus, in addition to alum itself, this category may even include high content of iron (Fe) and Calcium (Ca).

By location, satisfaction rate of Ba Tri (Ben Tre) is relatively low; only 31% of the responses were at satisfactory level. In fact, a number of responses to negative issues attributed to this district. As the average depth of wells in this area is shallow, wells can be easily contaminated with saline water. The issue of saline water was also observed in Vinh Chau of Soc Trang having four responses, while the

[14] In the areas of alluvium soil, repeated flooding and drying leaves a soil residue high in aluminum and magnesium sulphate and, as a result, shallow ground water becomes high in aluminum sulphate (alum) with an acid pH and high iron content.(http://pubs.usgs.gov/wsp/1608r/report.pdf)

issue of alum water was in Cang Long of Tra Vinh (4 responses) and Giong Trom of Ben Tre (3 responses). On the other hand, Phuoc Long (Bac Lieu) had no problematic issues on water quality; all the responses fell in the satisfactory level.

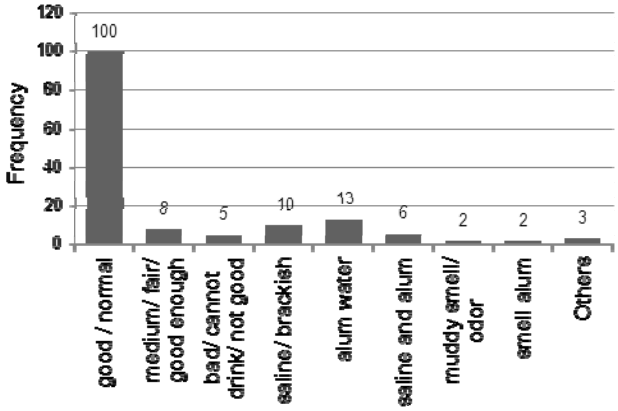


Figure 3.3.2 Issues in Water Quality of Wells

Source: Questionnaire Household Survey, JICA Project Team (2012)

Table 3.3.6 Issues in Water Quality of Wells

District	good / normal	medium/ fair/ good enough	bad/ cannot drink/ not good	saline/ brackish	alum water	saline and alum	muddy smell/ odor	smell alum	Others	Total
Ba Tri	8	1	3	6	5	6				29
	28%	3%	10%	21%	17%	21%	0%	0%	0%	100%
Cai Nuoc	37						1			38
	97%	0%	0%	0%	0%	0%	3%	0%	0%	100%
Cang Long	11	3			4		1	2	2	23
	48%	13%	0%	0%	17%	0%	4%	9%	9%	100%
Giong Trom		3			3					6
	0%	50%	0%	0%	50%	0%	0%	0%	0%	100%
Phuoc Long	33									33
	100%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Vinh Chau	11	1	2	4	1				1	20
	55%	5%	10%	20%	5%	0%	0%	0%	5%	100%
Total	**100**	**8**	**5**	**10**	**13**	**6**	**2**	**2**	**3**	**149**
	67%	**5%**	**3%**	**7%**	**9%**	**4%**	**1%**	**1%**	**2%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Approximately 70% of the respondents are satisfied with the water quality of wells.
- Saline, brackish, and alum water are the major issues pointed out.
- As a minor issue, bad smell (alum or muddy) are claimed.
- Ba Tri (Ben Tre) has relatively a large number of negative issues such as saline, brackish, and alumni.

3.4 Size of Farm Plot

1) Average Size of Farm Plot per Household

As shown in Figure 3.4.1, majority (56%) of the farm plots in the surveyed area are less than 1 ha. Of a total of 211 valid responses, 27% (56 responses) are less than 0.5 ha and 29% (62) were 0.5 to 1.0 ha. On contrary, 32% (68) of the respondents have farm plots with the size more than 2 ha, including 12

respondents who have more than 4 ha. As a result, an average size of farm plot per household is relatively big: 1.57 ha as shown in Table 3.4.1. An average agricultural production area per household in entire project area is 1.21 ha/household and in Mekong delta area is 1.20 ha/household (Rural, Agricultural and Fishery Census,2006). Thus, this result is slightly bigger than official statistic data. Meanwhile, agricultural land area per household of the whole country is just 0.81 ha and in Red River Delta is only 0.25, suggesting that average size in the Project area is relatively big.

Size of Farm Plot	Frequency	%
0.5	56	27%
1	62	29%
1.5	25	12%
2	23	11%
2.5	11	5%
3	11	5%
3.5	4	2%
4	7	3%
More	12	6%
Total	**211**	**100%**

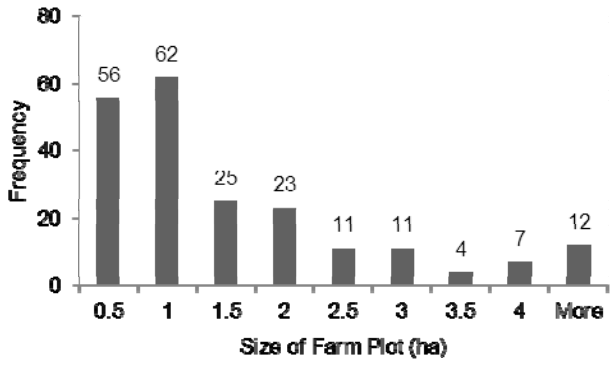


Figure 3.4.1 Frequency of the Responses by the Size of Farm Plot

Source: Questionnaire Household Survey, JICA Project Team (2012)

Specifically, an average size of farm plot in each district varies from 0.58 ha of Giong Trom (Ben Tre) to 2.58 ha of Phuoc Long (Bac Lieu). Clearly, average sizes in two districts of Ben Tre were smaller than other districts. In Ben Tre province, an average population density is comparatively large (532 people/km^2), as compared to 366 people/km^2 in the whole project area. Thus, high population density may have contributed to this smaller land holding in Ben Tre.

In addition, the maximum size of farm plot was 12.00 ha in Phuoc Long (Bac Lieu), which was followed by Ba Tri (10.00 ha) and Vinh Chau (9.00 ha). The minimum was then 0.04 ha of Cai Nuoc (Ca Mau), 0.09 ha of Ba Tri, and 0.10 ha in Giong Trom. Although the average size in Ba Tri was quite limited, maximum marked 10.00ha.

Table 3.4.1 Average Size of Farm Plot per Household (ha)

					Provincial Statistics		
District	Average (ha/HH)	Max (ha/HH)	Min (ha/HH)	No. of Samples	Average Land Area (ha/HH)	Populatin Density (P/km^2)	Province
Ba Tri	0.88	10.00	0.09	38	0.58	532	Ben Tre
Cai Nuoc	1.91	6.00	0.04	39	1.61	227	Ca Mau
Cang Long	1.32	2.70	0.35	30	1.03	438	Tra Vinh
Giong Trom	0.58	2.30	0.10	42	0.58	532	Ben Tre
Phuoc Long	2.58	12.00	0.68	41	1.66	347	Bac Lieu
Vinh Chau	2.53	9.00	0.26	21	1.51	393	Soc Trang
Total/Average	**1.57**	**12.00**	**0.04**	**211**	**1.21**	**366**	**Project Area**

Source: Questionnaire Household Survey, JICA Project Team (2012) and Statistical Yearbook of Vietnam, 2010, GSO

2) Average Size of Farm Plot per Family Member

Table 3.4.2, shows the average size of farm plot per family member. As shown in the table, average size is relatively small for paddy and fruits areas (0.19 ha/person), while shrimp-oriented areas are relatively large (i.e., 0.51 ha/person for shrimp/ shrimp-paddy area, 0.49 ha/person and 0.36 ha for shrimp area). On entire average, one person takes care of 0.34 ha of agricultural land, that is, approximately 60 meter squares. In the case of paddy, that is about 43 m or 55 m squares. In these scale of land area, it would be difficult for farmers to practice weed management, water management

and other works in an intensive way. As far as paddy cultivation is concerned, mechanized cultivation should be the standard farming system in the area, unless hiring labors.

Table 3.4.2 Average Size of Farm Plot per Family Member

District	Average Size (ha)	Average No. of Family Member	Area per Family Member (ha/person)	Main Commodity
Ba Tri	0.88	4.68	0.19	Paddy
Cai Nuoc	1.91	5.33	0.36	Shrimp
Cang Long	1.32	4.37	0.30	Paddy
Giong Trom	0.58	3.06	0.19	Fruits
Phuoc Long	2.58	5.07	0.51	Shrimp/Shrimp-Paddy
Vinh Chau	2.53	5.14	0.49	Shrimp
Total	**1.57**	**4.60**	**0.34**	

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- 56% of the respondents have their farm plots with a size of 1ha or less.
- Average size of farm plot per household is 1.57 ha
- By district, average size of farm plot in Ba Tri and Giong Trom are relatively small (less than 1.0ha), while that of Phuoc Long and Vinh Chau are big (more than 2.5ha).
- Average plot size per family member is 0.34 ha/person.

3.5 Paddy Production

1) Years of Experience in Paddy Cultivation

The farmers in the surveyed area have an average of 21 years of experience in paddy cultivation ranging from 1 year to 50 years. As shown in Table 3.5.1, there were no significant differences among the districts surveyed; farmers have 18 to 24 years of experience in each district. Note that there were no respondents who have any experience in paddy cultivation in Cai Nuoc and Giong Trom as they are selected as shrimp and fruits areas respectively.

Table 3.5.1 Years of Experience in Paddy Cultivation

District	Average	Max	Min	No. of Respondents
Ba Tri	24	50	5	32
Cai Nuoc				
Cang Long	20	40	1	30
Giong Trom				
Phuoc Long	18	47	2	26
Vinh Chau	24	40	4	4
Total	**21**	**50**	**1**	**92**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Average years of experience in paddy cultivation are 21 years, ranging from 1 to 50 years.

2) Number of Cultivation per Year

There are many types of paddy cropping patterns: one, two and three cropping per year, which are sometimes combined with other commodities including shrimp. For paddy-focused cropping, the most popular cropping pattern in the surveyed area of Ba Tri and Cang Long[15] is three cropping, which

[15] Those two districts were selected specifically as "paddy area." Although there could be such farmers who cultivate some other crops with paddy, it is not a major cropping pattern in those areas.

accounts for 81% of valid responses (68). The second popular pattern is two cropping (15%) and there are a few farmers who focus only on one time of cropping per year (summer-autumn only). On average, paddy-focused farmers cultivate 2.76 times a year in the area.

Table 3.5.2 Number of Cultivation per Year (Paddy Farmer Only)

District	No. of Samples	3 Cropping	2 Cropping				1 Cropping				Average No. of Cropping
		SA+AW+WS	SA+AW	AW+WS	WS+SA	Total	SA	AW	WS	Total	
Ba Tri	38	29	0	8	1	9	0	0	0	0	2.76
Cang Long	30	26	0	0	1	1	3	0	0	3	2.77
Total	**68**	**55**	**0**	**8**	**2**	**10**	**3**	**0**	**0**	**3**	**2.76**
	100%	**81%**	**0%**	**12%**	**3%**	**15%**	**4%**	**0%**	**0%**	**4%**	

Source: Questionnaire Household Survey, JICA Project Team (2012)
SA: Summer-Autumn, AW: Autumn-Winter, WS: Winter-Spring

3) Rice Varieties Cultivated

Table 3.5.3 summarizes the accumulated cultivated area of rice varieties in the surveyed area based on a total of 98 valid responses. The most popular varieties in the surveyed area are: IR50404 (23% of the total share), 1 Red Rice (18%), C10 (14%), OM6162 (13%), and OM4900 (11%). Rest of the varieties each have only 5% of share or less. The code of each variety represents the institute where that variety was developed. For example, "IR" varieties are developed by International Rice Research Institute (IRRI); "OM" varieties are developed by Cuu Long Rice Research Institute of MARD in Can Tho province.

Table 3.5.3 Rice Varieties Cultivated in the Surveyed Area

Variety	Ba Tri		Cang Long		Phuoc Long		Vinh Chau		Total	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
IR50404			30.0	51%					30.0	23%
1 Red rice					22.8	90%			22.8	18%
C10	17.9	43%							17.9	14%
OM6162	12.1	29%	5.1	9%					17.2	13%
OM4900	2.6	6%	11.4	19%					14.0	11%
504			6.3	11%					6.3	5%
OM2496	0.8	2%	5.1	9%					5.9	5%
OC10	4.5	11%							4.5	3%
ST5							3.0	75%	3.0	2%
OM Can Tho	3.0	7%							3.0	2%
1 White rice					2.5	10%			2.5	2%
IR5404			1.1	2%					1.1	1%
fragrant							1.0	25%	1.0	1%
KT19	0.6	1%							0.6	0%
OM536	0.5	1%							0.5	0%
Total	**41.9**	**100%**	**58.9**	**100%**	**25.3**	**100%**	**4.0**	**100%**	**130.2**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Cultivated areas are estimated based on the annual cultivated area of each respondent and share of each variety. Name of the varieties are based on the answer by each respondent. Although some unknown names have been reconfirmed, there still are some varieties not officially recognized.

According to the Cuu Long Rice Research Institute, the most popular variety in the Mekong Delta is "IR50404" accounting for 30% to 40% of the cultivated area in the Mekong Delta and "OM" varieties shares nearly 60%. Thus, the survey result from the questionnaire survey due reflects the overall tendency of the Mekong Delta. Reportedly, "IR50404" is given favor with its high yield. However, due to its high contents of amino acid, the taste is not so much favored and thus it is commonly powdered for food processing.

Short Summary

- Five rice varieties share the 79% of the cultivated area in the surveyed area namely: IR50404 (23%),

1 Red Rice (18%), C10 (14%), OM6162 (13%), and OM4900 (11%).

4) Reasons in Choosing Rice Varieties

There are multiple reasons for farmers to choose rice varieties to cultivate. As shown in Table 3.5.4, the most popular reason was "high productivity" with 67 responses, or 27% of a total of 246 responses to an open-ended multiple answering question. The second popular reason was the "taste of rice" given 52 responses (21%) and environmental tolerance to disease, drought, and alumni water having 51 responses (21%). Those three factors share 69% of the total responses.

Other factors listed were: stable productivity (8%), good price (5%), easiness of cultivation (4%), and so on. There were some cases in which negative factors were also pointed out coupled with positive factors. For example, "quality (taste) is good, although the productivity is medium;" and "taste is good, although it takes long time to get harvest."

Table 3.5.4 Reasons in Choosing Rice Varieties (Summary)

Code	Reasons to Choose the Variety	Responses	Share
1	High Productivity	67	27%
2	Good taste	52	21%
8	Environmental tolerance (disease, drought, alum w ater)	51	21%
5	Stable Productivity	19	8%
7	Good Price	13	5%
4	Easy to produce	10	4%
9	Strong stems	6	2%
3	Short maturity	6	2%
6	Good Marketability	1	0%
10	Others	21	9%
	Total	**246**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: The codes are also used in the table below. The reasons are sorted by the number of responses.

Furthermore, Table 3.5.5 shows the frequencies of responses given to specific varieties by types of factors. For example, IR50404 was given credit for its high productivity, although sample size is quite limited to this variety. "1 Red Rice," the second popular variety in the area (see Table 3.5.3), was given credit for its better marketability (Code 6, 21 responses), stable productivity (code 5, 10 responses), high productivity (code 1, 7 responses) and good taste (code 2, 7 responses). From the result, this variety seems to have a trait of good taste without losing certain level of productivity, leading to a high marketability potential.

Table 3.5.5 Reasons in Choosing Rice Varieties by Variety

Rice Variety	Reasons to Choose (Code)									
	1	2	3	4	5	6	7	8	9	10
1 Red rice	7	7			10	21	4			6
C10	18	1			1	12		1	1	2
OM4900	6	4	3	1	11	6	1			2
OM6162	5		2		8	1				
OC10	5					2	2			1
OM Can Tho	1	1			3	2	1		1	
64	3				2			1	1	
F1	2				2	1		1		
OM536		2			1	2				
6162	1				3					
61	1				1					1
504	2								1	
4218	1		1		1					
4900	1		1							1
50404	1		1			1				
DH1	1		1		1					
IR504	1	1				1				
IR50404	2									1
ST5					1			2		
Others	9	3	4		7	2	2	1	2	7
Total	**67**	**19**	**13**	**1**	**52**	**51**	**10**	**6**	**6**	**21**
	27%	**8%**	**5%**	**0%**	**21%**	**21%**	**4%**	**2%**	**2%**	**9%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Names of the varieties are based on the answer by each respondent. Although some unknown names have been reconfirmed, there still are some varieties not officially recognized.
Total number of responses given to each variety does not necessarily represent the popularity of the variety. For the popularity, please refer to Table 3.5.3.
The reasons coded by the number are listed in Table 3.5.4.

Short Summary

- To choose the types of rice varieties, farmers take into consideration "high productivity (27%)" the most, which is followed by "taste (21%)" and by "tolerance to environmental stress (21%)."
- Several factors are considered to one variety: for example, "1 Red Rice" was given credit for its good taste with certain level of productivity and the good marketability stems from good taste.

5) Places to Obtain Rice Seeds

Based on a total of 72 valid responses (Table 3.5.6), there are two major entities from which rice farmers obtain rice seeds: private company (36%) and other farmers (36%). It is implied that about one third of farmers purchase rice seeds from private company, while another one third of farmers may obtain recycled seeds from other farmers. Looking at the most popular variety, IR50404, there are more variations of the locations: four from private company, one from other farmers, two from cooperative and two from public organization (i.e. agricultural extension center). It suggests that cooperatives or public organizations focus only on some specific varieties that are being promoted or required by farmers. Note that none of the respondents obtain any rice seeds from NGO.

Generally, rice varieties are developed in Cuu Long Rice Research Institute at Can Tho province. Those varieties are then multiplied at selected districts partly for the stress test at the real field. If successfully produced, those seeds are then distributed to farmers through several channels, most importantly agricultural extension center at provincial level. Thus, private company and cooperative listed in the table also purchase originally from either Cuu Long Rice Research Institute or agricultural extension center as they themselves do not have any capacity to multiply seeds.

Table 3.5.6 Places to Obtain Rice Seeds

Row Labels	Private company	Other farmers	Cooperative	Public organization	NGO	Total
504	1	2	1			4
1 Red rice	6	3	1			10
1 White rice		1				1
C10	1	10		1		12
Chinese		1				1
fragrant	1					1
IR50404	4	1	2	2		9
IR5404	1			1		2
KT19		1				1
Nang Troi		1				1
OC10	2	1				3
OM Can Tho		2				2
OM2496		1	1			2
OM4900	3		2			5
OM5040		1				1
OM536	1					1
OM5404	1					1
OM5472	1					1
OM6162	3	1	3	4		11
ST5	1		2			3
Total	**26**	**26**	**12**	**8**		**72**
	36%	**36%**	**17%**	**11%**	**0%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Farmers obtain rice seeds mainly from private company (36%) and other farmers (36%).
- Limited types of varieties (ex. IR50404) are obtained from cooperatives or public organizations.
- No one obtain rice seeds from NGOs.

6) Establishing Method of Paddy

As shown in Table 3.5.7, the most common way of establishing paddy is broadcasting on average 66% of a total 220 responses. The second most common way is planting in row using seeder sharing 33%. On the other hand, transplanting is not common at all in the survey area. This tendency varies by the location; broadcasting dominates in Ba Tri (Ben Tre), while planting in row is the majority in Can Long (Tra Vinh). It is implied that use of machinery is already common in Cang Long, while manual practice is still dominant in Ba Tri. In addition, there is no significant difference among the planting season except Spring-Summer paddy in which enough number of samples were not obtained.

Table 3.5.7 Establishing Method of Paddy

District	Spring-Summer			Summer-Autum			Autum-Winter			Winter-Spring			Total		
	Broad Cast	In Row	Trans plant	Broad Cast	In Row	Trans plant	Broad Cast	In Row	Trans plant	Broad Cast	In Row	Trans plant	Broad Cast	In Row	Trans plant
Ba Tri				27	1		36	1		37	1		100	3	
Cai Nuoc															
Cang Long		1		8	22		8	21		8	22		24	66	
Giong Trom															
Phuoc Long	2	1		3			4	1		12			21	2	
Vinh Chau					1	1	1		1				1	1	2
Total	**2**	**2**		**38**	**24**	**1**	**49**	**23**	**1**	**57**	**23**		**146**	**72**	**2**
	50%	**50%**	**0%**	**60%**	**38%**	**2%**	**67%**	**32%**	**1%**	**71%**	**29%**	**0%**	**66%**	**33%**	**1%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Broadcasting is the most common way of establishing paddy (66%).
- In Can Long, planting in row using seeder is common (66 out of 90, 73%).
- In Ba Tri, broadcasting dominate the others (100 out of 103, 97%).
- There is no significant difference among the planting seasons.

7) Trend of Paddy Productivities (Average and Poor Harvesting Years)

Table 3.5.8 and Table 3.5.9 respectively summarize the yield of paddy in average year and poor harvesting year. Except Spring-Summer paddy which has only a limited number of samples (only one for average year and no for poor harvesting year), each cropping season maintain same level of productivity ranging from 7.1 ton/ha of Summer Autumn (SA) to 7.6 ton/ha of Winter Spring (WS) in average year and 2.8 ton/ha for the three listed cropping seasons in poor harvesting year.

As a whole, an average yield of all the cropping seasons in average year was 7.3 ton/ha based on a total of 181 valid responses. It is far beyond the average of either the Mekong Delta (4.9 t/ha for 2000-2010) or Project Area (4.6 t/ha), which is shown in Table 2.2.5.

On the other hand, an average yield of all the cropping seasons in poor harvesting year was 2.6 ton/ha based on a total of 52 valid responses. This low yield accounts for only 36% of the average year. In fact, there were 12 responses which indicated “loss of entire production” in poor harvesting year: two in Ba Tre (Ben Tre) and 10 in Phuoc Long (Bac Lieu).

Table 3.5.8 Yield of Paddy in Average Year

Item	SA	AW	WS	SS	Not Specified	Total
Ba Tri	4.7	4.6	5.6		5.0	5.0
Cai Nuoc						
Cang Long	9.0	9.3	11.2	11.0		9.9
Giong Trom						
Phuoc Long			5.7			5.7
Vinh Chau	4.3	6.0				5.2
Total	**7.1**	**7.1**	**7.6**	**11.0**	**5.0**	**7.3**
No. of Samples	**51**	**50**	**78**	**1**	**1**	**181**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Although the questionnaire asked the year of average harvest, only a few respondents returned the answer so no year information is available as “average year.”
AW (Autumn-Winter), SA (Summer-Autumn), WS (Winter-Spring) and SS (Spring-Summer)

Table 3.5.9 Yield of Paddy in Poor Harvesting Year

Item	SA	AW	WS	Not Specified	Total
Average w / zero	2.8	2.8	2.8	2.2	2.6
No. of Samples	12	6	14	20	52
Average w /o zero	2.8	2.8	3.9	3.7	3.3
No. of Samples	12	6	10	12	40

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: SS (Spring-Summer) was not returned from any respondents.
“Average without zero” is estimated without such data that shows “total loss.”

As shown Table 3.5.10, the poor harvest happened in various years based on the actual experiences of individual farmers for many reasons. Among all, the year when more farmers experienced poor harvesting was 2010 to which 23 responses were given. As Table 2.2.3 shows, provincial productions of cereals (majority is rice) in 2010 were as equal as other years. Therefore, this incident in 2010 might have been caused by site specific reasons such as miss-operation of sluice gate by which saline water came into the paddy field. To make sure, the number of samples for total loss of production were concentrated in Bac Lieu (10 sample).

Table 3.5.10 Years of Poor Harvesting of Paddy

Year	No. of Responses	%
1998	1	3%
2000	1	3%
2006	1	3%
2007	3	8%
2008	2	5%
2009	5	14%
2010	23	62%
2011	1	3%
Total	37	100%

Source: Questionnaire Household Survey, JICA Project Team (2012)

For confirmation, major factors of low productivity in the poor harvesting years are summarized in Table 3.5.11 based on a total of 96 responses. The most considerable factors to low productivity was drought with 31 responses (32% of the total), which was followed by flood with 22 responses (23%). Ironically, completely antagonistic factors became to be the biggest factors of low productivity. Although season-wise data are not available, it is most likely that those incidents have happened in different season, i.e., drought in dry season (winter-spring) and flood in rainy season (summer-autumn). In any case, this result implies a lack of capacity in the area in controlling water resources especially in Phuoc Long (Bac Lieu) where 17 responses each have been given to both factors.

On the bottom part of the table, the numbers of responses are shown which were given to the factors that attributed to the total loss of produces. Of total 14 responses, seven responses were given to "drought" while six were put on flood, having quite a similar tendency of entire result.

Table 3.5.11 Factors of Low Productivity in Poor Harvesting Year

District	Drought	Flood	Salinity	Pest/ Disease	Low Seed Quality	Total
Ba Tri	5	4	3	5	3	20
Cai Nuoc						
Cang Long	7	1	10	6		24
Giong Trom						
Phuoc Long	17	17	7	8		49
Vinh Chau	2				1	3
Total	**31**	**22**	**20**	**19**	**4**	**96**
	32%	**23%**	**21%**	**20%**	**4%**	**100%**
Reasons for total losses						
Ba Tri	1	1				2
Phuoc Long	6	5	1			12
Total	**7**	**6**	**1**	**0**	**0**	**14**
	50%	**43%**	**7%**	**0%**	**0%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Lower part of the table shows the numbers of responses to the factors for total losses.

Short Summary

- In average harvesting years, yield of paddy was around 7.3 ton/ha, having less variations among cropping seasons throughout a year.
- In poor harvesting year, an average yield was 2.6 ton/ha, only 36% of average years.
- The poor harvest occurred in 2010, due mainly to drought (32%), flood (23%), salinity (21%) and pest and diseases (20%).
- Total loss was caused by two major factors namely drought (50%) and flood (43%).

8) Possessions of Agricultural Machineries for Paddy Cultivation

There were a total of 96 respondents who possess any kind of agricultural machineries for paddy production. Of which, the most popular types of machinery were "pump" and "harvester" with 22 responses each (Table 3.5.12), which were followed by "tractor" (18) and "hand tractor" (17). Note that there was no response in Cai Nuoc and Giong Trom; paddy is not a major commodity in those areas. Upon the number of farmers who grow paddy, pump and harvester reached 24%, while combined harvester was only 5% of those who grow paddy.

Table 3.5.12 Possessions of Agricultural Machineries for Paddy Cultivation

Type of Machinery	Ba Tri	Cang Long	Phuoc Long	Vinh Chau	Total	%
Pump	1	9	11	1	22	24%
Harvester	13	8	1		22	24%
Tractor	9	6	2	1	18	20%
Hand Tractor/ Plough	14	1	2		17	18%
Rotary Harrow		5	5	2	12	13%
Combined Harvester	2	1	2		5	5%
Total	**39**	**30**	**23**	**4**	**96**	
No. of Farmers who grow paddy	**38**	**26**	**24**	**4**	**92**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: No. of farmer was estimated based on the number of data wherein income from paddy is availed.

In addition, 65 out of 96 machineries (68%) were found being periodically rented out. In the case of hand tractor/ plough, all the machines are used for rent, while no pumps are subjected to the rent. Different from other automotive-typed machineries, pumps are usually purchased to be used exclusively to farmers' own cultivation.

Furthermore, years of purchasing agricultural machineries are shown in Table 3.5.14. As of a total of 30 valid responses[16], only pump is being purchased every few years since the early 90's, while tractor and harvester were purchased only recently. Although the sample size is not large enough, it implies farmers in the area have been using pump to secure water resources since before. Then, they have recently gained financial capacity to purchase other agricultural machineries to cultivate paddy.

Table 3.5.13 Agricultural Machineries Rented Out

Type of Marhinery	No. of Machineries Possessed	No. of Machineries Rented Out	%
Pump	22	0	0%
Harvester	22	21	95%
Tractor	18	16	89%
Hand Tractor/ Plough	17	17	100%
Rotary Harrow	12	7	58%
Combined Harvester	5	4	80%
Total	**96**	**65**	**68%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

[16] Not all the respondents to the previous table answered to this question, thus smaller number of responses.

Table 3.5.14 Years of Purchasing Agricultural Machineries

Machinery	1985	1993	1995	1999	2000	2001	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total
Rotary Harrow								1	1			3				5
Tractor														1	1	2
Pump	1	1	2	1	3	1	1	2	2	3	2	1	2			22
Harvester													1			1
Total	**1**	**1**	**2**	**1**	**3**	**1**	**1**	**3**	**3**	**3**	**2**	**4**	**3**	**1**	**1**	**30**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- The most popular machinery that interviewed farmers possess for paddy production is pump and harvester, which are followed by tractor.
- 68% of agricultural machineries are rented out to the other farmers excluding pump.
- Pump has been continuously purchased and used since the early 90's.

9) Gross Income from Paddy Cultivation by Cropping Season

Economic nature of paddy cultivation by typical household was identified based on the sampled data for the year 2011. First of all, average data for area harvested, production, farm gate price, and gross income were estimated based only on valid data that have complete information for area, production and cost, that is, such data that lack either one of those information had been omitted from this estimation. For example, any sample which have cost data without production data are not included. Based on a total of 139 valid data, weighted average of all related information had been calculated and summarized.

As shown in Table 3.5.15, an average size of area harvested was 0.74 ha, which accounts for 47% of the entire farm plot per household (1.57ha/household, see Table 3.4.1). The size of paddy field does not change significantly by cropping season (0.73ha to 0.76ha). In this size of paddy field, an average of 4.86 ton/ha of production were harvested[17], in which the highest yield was marked in Summer-Autumn season (5.39 ton/ha), while the lowest was during Autumn-Winter season (4.27).

As per household, an average of 3,596kg of paddy were produced of which 3,088kg, or 86% of the production, were sold out; 46kg (1%) were kept as seeds for next season; and 462kg (13%) were consumed at home. An weighted average of farm gate price of paddy was 6,445VND/kg ranging from 6,365VND/kg for SA paddy to 6,591VND/kg for AW paddy.

Based on the production and price data, gross cash income from selling (financial value) and from production (economic value) were estimated. Note that the gross incomes indicated in the table were not calculated by a simple multiplication of averaged price and production but the average of individual data.

The estimated gross income in financial value (from selling) per one cropping season was 19,588,000 VND/household, ranging from 17,961,000 VND/household of AW paddy to 21,480,000 VND/household of SA paddy. On the other hand, gross income in economic value (from entire production) was found 22,838,000 VND/household, ranging from 21,933,000 VND/household of AW paddy to 24,125,000 VND/household of SA paddy. It means, if a farmer cultivate twice a year, 42,960,000 VND/household of gross income can be expected.

Thus, at an exchange rate of 20,721.22VND/US$ (as of April 18, 2012), typical rice-farming household earn a monetary value of 945US$ per cultivation from selling and produces as much value

[17] This is far lower than the yield presented in Table 3.5.8. This difference was caused in the process of data extraction; here only such data both net income and production cost are available were used (140 sample), while previous table include all the yield data (181 responses).

as 1,102US$ a season only from paddy cultivation on an average of 0.74 ha per cultivation per household.

Table 3.5.15 Production and Estimated Gross Income from Paddy Cultivation per Household

Cropping Season	Area Harvested	Yield	Production	For Seed	For Selling	For Home	Farm Gate Price	Gross Income (Financial)	Gross Income (Economic)
	(ha)	(ton/ha)	(kg)	(kg)	(kg)	(kg)	(VND/kg)	(VND)	(VND)
SA Paddy	0.74	5.39	3,974	69	3,541	364	6,365	21,480,000	24,125,000
AW Paddy	0.76	4.27	3,256	26	2,662	568	6,591	17,961,000	21,933,000
WS Paddy	0.73	4.79	3,483	38	2,971	474	6,398	18,940,000	22,202,000
Total. Ave.	**0.74**	**4.86**	**3,596**	**46**	**3,088**	**462**	**6,445**	**19,588,000**	**22,838,000**
			100%	**1%**	**86%**	**13%**			

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Income was estimated as a weighted average, not by the horizontal calculation in the table.
SS Paddy was excluded from the data as it has only one valid sample
Total average was estimated based on the weighted average of all the valid data, not the average of above figures
Financial: Based on the amounts which are sold out. Economic: Based on the amounts which are produced.

In terms of income per hectare, average income was estimated 26,470,000VND/ha for financial value and 30,862,000 VND/ha for economic value as shown in Table 3.5.16. Those are respectively 1,277US$/ha and 1,489US$/ha per cultivation.

Table 3.5.16 Production and Estimated Gross Income from Paddy Cultivation per Hectare

Cropping Season	Production	For Seed	For Selling	For Home	Farm Gate Price	Gross Income (Financial)	Gross Income (Economic)
	(kg)	(kg)	(kg)	(kg)	(VND/kg)	(VND)	(VND)
SA Paddy	5,390	94	4,803	494	6,365	29,135,000	32,722,000
AW Paddy	4,266	34	3,488	744	6,591	23,534,000	28,738,000
WS Paddy	4,792	52	4,088	652	6,398	26,060,000	30,549,000
Total. Ave.	**4,859**	**62**	**4,173**	**624**	**6,445**	**26,470,000**	**30,862,000**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Income was estimated as a weighted average, not by the horizontal calculation in the table.

Short Summary

- An average size of area harvested was 0.74 ha/household.
- An average yield of paddy was 4.86 ton/ha.
- An average production of paddy per household was 3,596kg, of which 86% were sold out.
- An average farm gate price was 6,445 VND/kg.
- An estimated gross income from selling (financial value) was 19,588,000VND (US$945).
- An estimated gross income from production (economic value) was 22,838,000VND (US$1,102).

10) Cost for Paddy Cultivation per Cropping Season

Labor and Outsourcing Cost

Table 3.5.17 summarizes an average total cost of labor and outsources for paddy cultivation based on a total of 82 valid responses. The target responses are those which have complete data for both income and labor costs. In the table, cost was estimated based on simple average of all the 82 samples item by item, some of which may have no disbursement at all. As a result, cost of such items that farmers rarely disburse became to be smaller than usually disbursed; for example, cost of "soil pudding" was approximately 765,000VND for those who *actually* outsource it, while the average cost of all the responses was 9,329 VND, suggesting less farmers outsource soil pudding.

For comparison, "typical cost" of the table shows an average of only the responses that have actual

disbursement (excluding zero value) with the number of responses which have values more than zero. It should be also noted that there are multiple items used for establishment of paddy: "seeding (broadcast), seeding (in row) and transplanting. It does not mean that the model farmer disburses for each of three items but it shows typical picture of entire respondents.

Table 3.5.17 Labor and Outsourcing Costs for Paddy Cultivation per Household

Item	Cost (VND)	%	Typical Cost (Reference)	No. of Responses
Land Cleaning	346,098	3.9%	1,351,429	21
Plowing	**1,530,195**	**17.0%**	1,872,776	67
Saline Leaching	7,805	0.1%	640,000	1
Soil Pudding	9,329	0.1%	765,000	1
Seeding (broadcast)	695,144	7.7%	1,540,589	37
Seeding (in row)	301,476	3.4%	1,648,067	15
Transplanting	121,951	1.4%	3,333,333	3
Fertilizer Application	191,512	2.1%	3,140,800	5
Pesticide/fungicide Application	49,390	0.5%	810,000	5
Herbicide Application	8,902	0.1%	243,333	3
Weeding	140,244	1.6%	1,045,455	11
Harvesting	**3,600,841**	**40.1%**	3,645,296	81
Threshing	789,512	8.8%	1,471,364	44
Transporting (farm to dry yard)	**934,024**	**10.4%**	1,781,163	43
Drying/packing	30,488	0.3%	625,000	4
Transporting (dry yard to market)	10,976	0.1%	300,000	3
Water Fee	201,311	2.2%	1,500,682	11
Land Tax	16,098	0.2%	660,000	2
Total Cost of Labor/Out Source (Rounded)	**8,985,000**	**100.0%**		**82**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Note: Cost of each item represents the average of all the responses including those which were not born (zero value) Instead, typical cost shows the average of only those which were actually born excluding zero value.
Only total cost is rounded to the nearest thousand.
"No. of responses" shows the number of responses that have values more than zero, which were applied to estimate "typical cost."

Now, the total cost for labor and outsources was estimated on average 8,985,000VND per cultivation based on a total of 82 valid responses. As of the share of each item to the total cost of labor, cost of harvesting shares the most with 3,600,841VND or 40.1% of the total cost, which is followed by plowing with 1,530,195 VND (17.0%) and transporting from farm to dry yard (10.4%). Those three items share 67% of the total cost as an average of simple average of 82 responses.

Cost of Inputs

Table 3.5.18 summarizes the average cost of inputs applied to paddy cultivation by cropping season. As shown in the table, there are a total of five main types of inputs used for paddy cultivation: urea, compound, compost, pesticide/fungicide, and herbicide. As a whole, the total cost of inputs was averaged to be 4,117,000VND per cultivation ranging from 3,686,000VND of WS paddy to 4,479,000VND of AW paddy. Among all, the cost of urea shared 51% of the total input costs (2,081,000VND). The second biggest cost was compost (20%).

In the Mekong Delta, it is common to cultivate paddy twice or even three times a year, leading to a higher risk on deterioration of soil condition. In this setting, one of the issues that enable the rice cultivation sustainable is the periodical flood that brings necessary nutrition to the paddy field (30% of the valid responses receives periodical flood as shown in Table 3.10.1). In addition, it was found that farmers use compost for paddy cultivation—implying that farmers already recognize the difficulty in continuing paddy cultivation without application of organic matters.

Table 3.5.18 Cost of Inputs for Paddy Cultivation per Household

Cropping Season	Urea	Compound	Compost	Pesticide/ Fungicide	Herbicide	Total Cost of Input	Cost of Labor & Outsource	Total Cost for Production
	(VND)	(VND)	(VND)	(VND)	(VND)	(VND)	(VND)	(VND)
SA Paddy	2,071,000	654,000	822,000	385,000	252,000	4,184,000	8,985,000	13,169,000
AW Paddy	2,372,000	763,000	858,000	290,000	197,000	4,479,000	8,985,000	13,464,000
WS Paddy	1,808,000	649,000	753,000	290,000	186,000	3,686,000	8,985,000	12,671,000
Average	**2,081,000**	**686,000**	**811,000**	**325,000**	**214,000**	**4,117,000**	**8,985,000**	**13,102,000**
	51%	**17%**	**20%**	**8%**	**5%**	**100%**		
	16%	**5%**	**6%**	**2%**	**2%**	**31%**	**69%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

As shown in Table 3.5.19, among a total of 139 responses that bear at least one item of input cost, 87 responses were given to compost, that is, 63% of "input users" apply compost. In this regard, the most popular item was urea that 97% of valid respondents use. The least popular item was compound fertilizer having 86 (62%) responses. It seems farmers prefer using urea to compound fertilizer as top dressing.

Table 3.5.19 Number of Responses Applying Designated Inputs per Household

Cropping Season	Urea	Compound	Compost	Pesticide/ Fungicide	Herbicide	Total Cost of Input
SA Paddy	51	35	29	49	50	52
AW Paddy	41	24	29	40	40	43
WS Paddy	43	27	29	42	41	44
Total	**135**	**86**	**87**	**131**	**131**	**139**
	97%	**62%**	**63%**	**94%**	**94%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

In terms of the amount of fertilizers applied, Urea is the biggest with 245kg/ha on an average of three cropping seasons. Then, average amount of compound is 98kg/ha—an average total amount of chemical fertilizer results in 343kg/ha. In addition, it was found that on average 150 kg/ha of compost is also applied.

Table 3.5.20 Amount of Fertilizer Applied per Hectare for Paddy Cultivation

Cropping Season	No. of Samples	Urea (kg/ha)	Compound (kg/ha)	Compost (kg/ha)	Total (kg/ha)
SA Paddy	63	243	114	142	500
AW Paddy	69	247	97	158	502
WS Paddy	70	244	82	151	476
Average	**202**	**245**	**98**	**150**	**493**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Total Cost of Paddy Cultivation

As already shown in Table 3.5.18, a total cost of paddy production was estimated by cropping season, although the cost of labor was estimated by common data applicable to all the cropping seasons. The total amount was found 13,102,000 on average, ranging from 12,671,000VND of WS paddy to 13,464,000VND of AW paddy. The difference among the cropping seasons was caused probably by the amount of inputs applied, or it is just within a range of error.

Among the total cost, cost of labor and outsourcing shares 69% (see the bottom raw of the Table 3.5.18), while the cost of inputs shares 31%. Large portions of labor works are already mechanized in the area, but if the cost of labor would increase in future, cost structure of paddy cultivation would largely be affected. In fact, share of agriculture sector in the labor force structure of the Mekong Delta had lost 7%, which in turn shifted into industry (+3.5%) and services (+3.5%) due to the structural

change of the economy.[18]

Short Summary

- Average labor cost for paddy cultivation was 8,985,000VND per cultivation, of which cost for harvesting shares 40.1%.
- Average input cost was 4,117,000VND per cultivation, of which cost of urea shares 51%.
- Accumulated total cost of paddy cultivation was estimated 13,102,000VND, of which labor cost shares 69% while the cost of inputs share 31%.

11) Net Income from Paddy Cultivation

Estimated net income from paddy cultivation is summarized in Table 3.5.21 based on a total of 139 valid responses except the cost of labor which have been independently calculated as discussed in the previous section. As shown in the table, upon an average of 0.74 ha of harvested area per household, an average of 19,588,000 VND of gross cash income are gained and economic values of 22,838,000VND are produced. Given the total cost of production, 13,102,000 VND, estimated net income is calculated 6,486,000 VND, or US$313, at financial value and 9,736,000 VND, or US$470, at economic value.

In addition, the result was converted into an expected net income per area: 13,122,000VND, or US$633. By cultivating one hectare of paddy, farmers can expect approximately US$633 of net income, and if double cropping can be managed in a year, the expected net income can be also doubled to be US$1,266.

Table 3.5.21 Estimated Net Income from Paddy Cultivation

Cropping Season	AREA Harvested	Gross Cash Income (Financial)	Gross Cash Income (Economic)	Total Cost	Total Net Income (Financial)	Total Net Income (Economic)	Total Net Income per ha (Economic)	No. of Samples
	(ha)	(VND)	(VND)	(VND)	(VND)	(VND)	(VND)	(No.)
SA Paddy	0.74	21,480,000	24,125,000	13,169,000	8,311,000	10,956,000	14,860,000	52
AW Paddy	0.76	17,961,000	21,933,000	13,464,000	4497000	8,469,000	11,097,000	43
WS Paddy	0.73	18,940,000	22,202,000	12,671,000	6269000	9,531,000	13,114,000	44
Total. Ave.	**0.74**	**19,588,000**	**22,838,000**	**13,102,000**	**6,486,000**	**9,736,000**	**13,122,000**	**139**
		US$945	**US$1,102**	**US$632**	**US$313**	**US$470**	**US$633**	
						Exchange Rate (VND/US$)		**20,721.22**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: SS Paddy had only one valid sample; therefore, it was excluded from the calculation.
Total average was estimated based on the weighted average of all the valid data, not the average of above figures.
Financial: Based on the amounts which are sold out.
Economic: Based on the amounts which are produced.

Furthermore, net income per household was estimated based on the above figures. As shown in Table 3.5.2, an average number of cultivation of paddy for paddy-focused household is 2.76 times per year. Thus, net income per paddy household is accordingly estimated in Table 3.5.22. Based on the simple multiplication, total area harvested reaches 2.05 ha/household/year, wherein net income (financial) is 17,901,000 VND (US$864) and net income (economic) results in 26,871,000 VND (US$1,297).

[18] "The economic transition and migration of Vietnam and the Mekong Delta region (December 2011)" http://mpra.ub.uni-muenchen.de/36387/1/MPRA_paper_36387.pdf. In the reference, it was mentioned that structural change in labor force was however much milder than the change in the share of agriculture in GDP.

Table 3.5.22 Summary of Net Income from Paddy Cultivation

				Exchange Rate (VND/US$)		20,721.22
				Cropping per Year		2.76
Category	AREA Harvested	Gross Cash Income (Financial)	Gross Cash Income (Economic)	Total Cost	Total Net Income (Financial)	Total Net Income (Economic)
	(ha)	(VND)	(VND)	(VND)	(VND)	(VND)
Per Cropping	0.74	19,588,000	22,838,000	13,102,000	6,486,000	9,736,000
		US$945	US$1,102	US$632	US$313	US$470
Per Hectare	1.00	26,400,000	30,780,000	17,658,000	8,742,000	13,122,000
		US$1,274	US$1,485	US$852	US$422	US$633
Per year per Household	2.05	54,063,000	63,033,000	36,162,000	17,901,000	26,871,000
		US$2,609	US$3,042	US$1,745	US$864	US$1,297

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Estimated net cash income from selling was on average 6,486,000VND or US$313.
- Estimated net income in the value of production was on average 9,736,000VND or US$470.
- The economic value of production per hectare is estimated 13,122,000 VND or US$633.
- Net income per household is on average 17,901,000VND or US$864 for financial value
- Net income per household is on average 26,871,000VND or US$1,297 for economic value

3.6 Fruits Production

1) Planted Area and Gross Income

Table 3.6.1 summarizes current situation of fruits production in the surveyed area: area planted, area harvested, selling amount, farm gate price, and gross cash income. As shown in the table, the most common fruit in the area was coconut, having a total of 52 responses out of a total of 63 responses, composed of 11 responses in Cang Long (Tra Vinh) and 41 responses in Giong Trom (Ben Tre). In addition, although the numbers of responses were quite limited, several other fruits crops are being cultivated: guava, lemon and orange, lemon, orange, sugarcane, and fruit as a general term.

As an average of those who cultivate any kinds of fruits crops—namely a total of 63 responses, an average area planted reached 0.43 ha per household, accounting for 27% of an average 1.57 ha of farm plot per household (see section 3.4). Note that while the average size of farm plot per household discussed in section 3.4 is based on the full scale of samples surveyed, the size of planted area for fruits is based only on those who cultivate fruits. Therefore, if all the samples are concerned, the average size of the planted area for fruits would be quite small.

An average size of area harvested for fruits resulted in 0.39 ha per household, accounting for 91% of the planted area. Then, gross cash income per household resulted in an average of 31,249,000VND/household for coconut, and 28,309,000VND/household for all types of fruits. In the value of gross income per planted area, the average reached 65,233,000VND/ha for coconut and 65,820,000VND for all the fruit crops. Specifically, it ranged from 50,000,000 VND/ha of sugarcane to 150,000,000 VND/ha of guava (although sugarcane is not commonly a fruit crop, it was suggested by the interviewee as fruit). Yet, the number of samples others than coconut is quite limited and the figures are just for reference.

Table 3.6.1 Planted Area, Harvested Area, Selling Amount and Gross Income from Fruits

Fruits by District	No. of Samples	Area Planted	Area Harvested	Selling Amount	Farm gate Price	Gross Cash Income per household	Gross Cash Income per Planted Area
	(Nos)	(ha)	(ha)	(Fruit)	(VND/Fruit)	(VND)	(VND/ha)
Coconut							
Cang Long	11	0.32	0.28	1,445	8,400	12,762,000	40,109,000
Giong Trom	41	0.52	0.48	4,118	8,732	36,209,000	69,340,000
Total/Average	52	0.48	0.44	3,552	8,662	31,249,000	65,233,000
	(Nos)	(ha)	(ha)	(kg)	(VND/kg)	(VND)	(VND)
Fruits							
Giong Trom	2	0.23	0.23	3,000	8,500	25,500,000	113,333,000
Guava							
Phuoc Long	1	0.02	0.02	500	6,000	3,000,000	150,000,000
Lemon+Orange							
Giong Trom	1	0.18	0.18	4,000	5,000	20,000,000	114,286,000
Lemon							
Giong Trom	3	0.28	0.28	3,867	3,667	12,000,000	42,353,000
Orange							
Giong Trom	2	0.24	0.24	1,350	15,000	20,250,000	86,170,000
Sugarcane							
Giong Trom	1	0.22	0.22	10,000	1,100	11,000,000	50,000,000
Grand Total/ Ave	**63**	**0.43**	**0.39**			**28,309,000**	**65,820,000**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Unit of selling amount for coconut is "fruit" and for others is "kg"
Unit of farm gate price for coconut is "VND/fruit" and for others is "VND/kg"

To add with, fruit production was concentrated in Giong Trom among others; 50 respondents out of a total of 63 responses. It can be said that Giong Trom area is comparatively a fruit-oriented area.

2) Years after Establishing Perennial Crops

Table 3.6.2 shows an average year after establishing each type of perennial crop (fruits). As an overall average of a total of 46 valid responses, years after establishing fruit crops were 4.5 years ranging from 1.7 years of guava to 4.8 years of coconut. As a common picture of the area, it can be said coconut plantation is a major type of perennial crops in the surveyed area today.

Table 3.6.2 Years after Establishing Perennial Crops

Type of Crop	No. of Samples	Years After Establishing
Coconut	40	4.8
Fruits (n.s.)	2	3.0
Guava	1	1.7
Lemon	1	2.0
Orange	2	3.0
Total	**46**	**4.5**

Source: Questionnaire Household Survey, JICA Project Team (2012)

3) Cost of Perennial Crop Production

Average cost of perennial crop production is summarized in Table 3.6.3. Based on a total of 52 valid responses for coconut production, establishment cost of coconut was found 823,000VND/household with an average size of farm plot 0.48 ha. As the establishment cost is just an initial cost, it is converted to a yearly value. To be the safe side in this estimation, instead of applying expected years of harvesting, establishment cost was divided by the average years after establishment derived from the questionnaire interview. The amount of yearly value reached 171,000VND/household.

Table 3.6.3 Cost of Perennial Crop Production

Crop	Coconut	%	Fruit (n.s.)	Lemon
Number of Samples	52		2	3
Planted Area (ha)	0.48		0.33	0.82
Land Prep.	75,000		0	0
Seedling	748,000		1,700,000	233,000
Transplanting	0		0	0
Others	0		0	0
Sub total (establishment)	823,000		1,700,000	233,000
Years after Establishing	4.8		1.7	2.0
Cost per Year* (A)	171,000	4%	1,000,000	117,000
Fertilizer	2,687,000	66%	3,000,000	3,667,000
Fertilizer Application	3,000	0%	0	0
Chemicals	54,000	1%	500,000	233,000
Chemical Application	0	0%	0	0
Pruning	706,000	17%	500,000	1,667,000
Watering/ irrigation	15,000	0%	0	133,000
Harvest	194,000	5%	0	0
Transportation	95,000	2%	0	0
Other Labor Cost	173,000	4%	0	333,000
Sub total (Recurrent) (B)	3,926,000	96%	4,000,000	6,033,000
Total Cost per Household (C=A+B)	**4,097,000**	**100%**	**5,000,000**	**6,150,000**
Total Cost per planted Area (VND/ha)	**8,553,000**		**15,385,000**	**7,531,000**

Source: Questionnaire Household Survey, JICA Project Team (2012)
*: To acquire yearly value of establishment cost, expected years for harvesting should be applied. However, to be safety side, years after establishing were taken here.
Note: As the number of samples other than coconut is quite limited, the figures are just for reference.

Then, the recurrent cost of coconut production is shown in the lower table. It costs an average of 3,926,000VND/household, accounting for 96% of the total cost. Specifically, cost of fertilizer shares the biggest part of the total cost (66%), which is followed by pruning (17%). After all, the cost of coconut production per household was 4,097,000VND and per hectare was 8,553,000VND. Note that data on production cost of other items namely fruit (not specified) and lemon have only limited samples (two and three respectively) and therefore the table shows the value only for reference.

4) Net Income from Perennial Crop Production

Based on the average gross income and cost, net income was estimated and summarized in Table 3.6.4. As for coconut, annual net income was averaged 27,152,000VND/household (0.48 ha/household), which is equivalent to US$1,310/household at an exchange rate of 20,721.22VND/US$. As per planted area, the estimated net income of coconut reached 56,680,000VND/ha or US$2,735/ha.

Table 3.6.4 Cost of Perennial Crop Production

Crop	Per Household (VND/Household)			Area per Household (ha)	Per Hectare (VND/ha)		
	Gross Income	Cost of Production	Net Income		Gross Income	Cost of Production	Net Income
Coconut	31,249,000	4,097,000	27,152,000	0.48	65,233,000	8,553,000	56,680,000
Fruit (n.s.)	25,500,000	5,000,000	20,500,000	0.33	78,462,000	15,385,000	63,077,000
Lemon	12,000,000	6,150,000	5,850,000	0.82	14,694,000	7,531,000	7,163,000

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: As the number of samples other than coconut is quite limited and thus the values are just for reference.

5) Consideration on the Price of Fruits

Given an average farm-gate price of 8,662 VND/fruit, coconut production seems to be comparatively

attractive. However, different from paddy, price of fruits fluctuate sometimes quite sharply. For example, retail price of a dozen of coconuts was around 140,000-150,000VND in October 2011, which had "sharply and suddenly" decreased by February 2012, 34,000-40,000, approximately 70% of decrease in a short time[19].

According to the source, approximately 90% of the coconut products in Ben Tre province, for example, are exported, including Europe, North Africa, and the middle-east, of which 35% points are accounted for china. As the result, price of coconuts is heavily affected by the world market trend, especially China. Due to the financial crisis originated in Greek, the world's economic condition especially in Europe stays in a relatively bad mode, and thus fruits farmers may not be able to see clear picture for the future.

Fruits farmers in the Project Area also have similar experience in watermelon as well that was also hit by the sudden and sharp decrease of demand especially from China. On contrary, it is reported that durian, guava (a variety without seeds), green citrus, and star apple are performing well in 2012. Green citrus is especially stable as it is consumed for the local diets.

To be sure, profitability of fruits production is largely affected by the market trend and thus risk is relatively high. Instead of depending solely on the result from questionnaire household survey, therefore, it is needed to consider the risk of fruits production when land use is planned.

3.7 Livestock Production

1) Cost and Income

Table 3.7.1 summarizes cost and income from livestock productions. The table shows the two sets of different figures: one derived from all the valid data for each item and another from only the data which are more than zero value for reference. For example, if there was only one sample that bears the cost of medicine among 21 valid samples (a case of cow production), the latter shows the value of that one sample to see how much cost farmers bear the, if applicable.

[19] Vietnam Business and Economy News (February 17, 2012)
http://www.vneconomynews.com/2012/02/coconut-prices-drop-worry-for-mekong.html

Table 3.7.1 Cost and Income from Livestock Production

Species	Item	All Valid Data			More than zero value only	
		No. of Samples	Average	%	No. of Samples	Average
COW	Number being raised	22	3.3		22	3.3
	Production a year	22	2.5		20	2.8
	Farm Gate Price per head	20	14,038		20	14,038
	Gross Cash Income (A)	22	35,898		20	39,488
	COW Baby	21	23,190	96%	21	23,190
	Medicine	21	1	0%	1	20
	Feed	20	2,050	9%	6	6,833
	Copulation	22	62	0%	4	340
	Other Labor Cost	22	0	0%	0	0
	Total Cost (B)	22	24,063	100%	22	24,063
	Net Income (A-B)		**11,835**			**15,425**
PIG	Number being raised	23	6.5		23	6.5
	Production a year	20	25.7		20	25.7
	Farm Gate Price per head	21	3,338		21	3,338
	Gross Cash Income (A)	21	68,789		20	72,229
	PIG Baby	19	7,253	22%	19	7,253
	Medicine	22	787	2%	12	1,443
	Feed	22	16,659	50%	11	33,318
	Copulation	22	254	1%	8	698
	Other Labor Cost	22	9,682	29%	2	106,500
	Total Cost (B)	22	33,600	100%	20	36,960
	Net Income (A-B)		**35,189**			**35,269**
CHICKEN	Number being raised	15	48.7		15	48.7
	Production a year	14	127.3		14	127.3
	Farm Gate Price per head	14	121		14	121
	Gross Cash Income (A)	14	10,357		14	10,357
	CHIKEN Baby	17	788	63%	10	1,340
	Medicine	17	124	10%	5	420
	Feed	16	63	5%	1	1,000
	Copulation	16	0	0%	0	0
	Other Labor Cost	16	306	24%	1	4,900
	Total Cost (B)	17	1,259	100%	13	1,646
	Net Income (A-B)		**9,098**			**8,711**
DUCK	Number being raised	4	21.3		4	21.3
	Production a year	3	33.3		3	33.3
	Farm Gate Price per head	3	100		3	100
	Gross Cash Income (A)	4	2,450		3	3,267
	DUCK Baby	5	100	17%	1	500
	Medicine	5	0	0%	0	0
	Feed	5	500	83%	1	2,500
	Copulation	5	0	0%	0	0
	Other Labor Cost	5	0	0%	0	0
	Total Cost (B)	5	600	100%	2	1,500
	Net Income (A-B)		**1,850**			**1,767**
GOAT	Number being raised	1	1.0		1	1.0
	Production a year	1	1.0		1	1.0
	Farm Gate Price per head	1	1,000		1	1,000
	Gross Cash Income (A)	1	1,000		1	1,000
	GOAT Baby	1	200	80%	1	200
	Medicine	1	50	20%	1	50
	Feed	1	0	0%	0	0
	Copulation	1	0	0%	0	0
	Other Labor Cost	1	0	0%	0	0
	Total Cost (B)	1	250	100%	1	250
	Net Income (A-B)		**750**			**750**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Data shows the averages of all the valid data corresponding to each of those items except net incomes which were calculated based on the average values in the table.

As shown in the table, the average number of cows the respondents were raising was 3.3 head, of which 2.5 cows were produced per year. Then, with an average unit price of cow of 14,038,000VND/head, gross cash income reached 35,898,000VND/year/household. The major cost of production was for purchasing calf on an average of 23,190,000VND, which shares 96% of the total cost of production. Then, an average net income was estimated 11,835,000VND.

To add with, there were only a limited number of respondents who actually bear the recurrent cost other than calf (baby cow). For example, there was only one respondent who purchased medicine, four who outsourced copulation, and six who bought feeds. In addition, there were two respondents who did not sell cows, resulting in lower gross income for the average of all valid data.

Secondly, swine production was also found common in the surveyed area. On average, the respondent maintained 6.5 heads of swine per household, producing 25.7 heads of swine a year. As a result, farmers gained 68,789,000VND of gross income and, deducting a total of 33,600,000VND for production cost, farmers got 35,189,000VND a year. Different from cow rearing, the biggest portion of the cost was feed, accounting for 50% of the total cost, which was followed by other labor cost (29%) and piglet (22%).

Next, it was revealed that the respondents rear on average 48.7 chickens per household, producing a total of 127.3 chickens per year. Given 121,000VND/chicken of selling price, then, farmers can expect on average 10,357,000VND of gross income. The cost of rearing chicken was averaged 1,259,000VND, composed mainly of baby chicks (788,000VND, 63% of the total cost), labor cost (306,000VND, 24%) and medicine (124,000VND, 10%). As a result, the averaged net income reached 9,098,000VND/year.

In addition, duck and goat were also addressed, although the number of respondents was limited. As shown in Table 3.7.1, an average gross income, total cost and net income of duck were 2,450,000VND, 600,000VND, and then 1,850,000VND respectively. For goat, based only on one sample, those were 1,000,000VND, 250,000VND and 750,000VND.

Overall, based on limited number of samples available, the most profitable type of livestock among all was swine, having 35,189,000VND of net income, which was followed by cow, generating 11,835,000VND of net income. This difference is probably based on the different structure of production system of both livestock: while mother swine bear a lot number of new generations to be sold, farmers usually purchase calf (baby cow) and raise it for selling after a while.

3.8 Net Income of Major Cropping Patterns per Model Household

Based on the findings derived from the household survey in seven villages supplemented by additional shrimp survey, this sub-section simulates general picture of household economy based on production of paddy, shrimp, fruits and livestock. To begin with, outline of typical agricultural-aquacultural household is drawn as follows in terms of average planted area of three major commodities per household, namely paddy, shrimp, and fruits (Table 3.8.1).

1) Ratio of Each Crop Planted per Household

According to the result of household survey, there are a total of seven types of cropping patterns recorded, which includes mono-cropping of paddy, shrimp, fruit, and various combination among several commodities. Of a total of 164 valid responses (based on area data only), the largest number of samples is found for mono-cropping of paddy (50), followed by mono-culture of shrimp (36), and fruits (30). Also there are a few data for such combinations: paddy-shrimp (6) and paddy-fruits (7).

Based on those samples, average planted area per household was estimated for each of those cropping

patterns. For example, 1.46 ha of land is planted for paddy mono-cropping, while 1.72 ha of paddy and 1.57 ha of shrimp are planted for paddy-shrimp pattern. With this data set, ratio among paddy, shrimp, and fruits was calculated as shown in the right columns of the table. For example, under paddy-fruits pattern, 86% of the area is planted for paddy, while 14% is for fruits.

Note that, under paddy-shrimp cropping, shrimp is usually cultivated after the harvest of paddy. Therefore, for the calculation of the "total" area of this pattern, the value of paddy (larger) was taken (shown at the bottom). This estimation is based on the data which entails area data regardless of the other data. Therefore, average land area per household is not necessarily the same as those indicated in the other section of the report.

Table 3.8.1 Average Planted Area per Household by Cropping Pattern

Cropping Pattern	No. of Samples	Area Planted (ha)				Ratio (%)		
		Paddy	Shrimp	Fruit	Total	Paddy	Shrimp	Fruit
Paddy	50	1.46	0.00	0.00	1.46	100%	0%	0%
Paddy-Shrimp	6	1.72	1.57	0.00				
Shrimp	36	0.00	2.10	0.00	2.10	0%	100%	0%
Paddy-Livestock	22	0.46	0.00	0.00	0.46	100%	0%	0%
Fruits	30	0.00	0.00	0.55	0.55	0%	0%	100%
Fruits-Livestock	13	0.00	0.00	0.58	0.58	0%	0%	100%
Paddy-Fruits	7	1.40	0.00	0.22	1.62	86%	0%	14%
Total/Ave	**164**	**0.63**	**0.52**	**0.16**	**1.30**	**48%**	**40%**	**12%**
Paddy-Shrimp (adj)		1.72	1.57	0.00	*1.72*	100%	91%	0%
Total/Ave					**1.21**			

Note: livestock is not included as area of livestock was not covered by the questionnaire survey.
Total area of "paddy-shrimp" pattern shows the area of paddy, considering the actual cultivation arrangement.
This dataset is tabulated based only on the area data availed in the original dataset. Thus the estimated average area per household may not necessarily match with those indicated in other section of the report.

2) Estimated Net Income by Major Commodity

Estimated net income from major commodity is re-arranged herewith in accordance with the estimations discussed in the other sections of the report. As shown in Table 3.8.2, estimated net income from paddy is 36,217,000VND/ha/year, while that of shrimp (average of multiple intensities) results in 31,289,000VND/ha/year. Although income level of fruits (coconut) is subject to a fluctuation, this estimation relies on the findings from the household survey.

Table 3.8.2 Average Income and Expenditure from Major Commodities per Hectare

(Unit: 000VND/ha)

Commodity	Gross Income	Cost	Net Income	Adjusted	Remarks
Paddy (time)	30,780	17,658	13,122		Just for reference of one cropping
Paddy (year)	84,953	48,736	36,217		2.76 times per year
Shrimp (with paddy)	33,266	9,517	23,749		Based on shrimp survey
Shrimp (ave)	69,194	30,083	39,111	31,289	*ditto*
Fruits	65,233	8,553	56,680		Based on coconut
Livestock				19,638	Ave (supplimental to other crops)

Note: data on "paddy (time)" was multiplied by 2.76 times/year to be a yearly value.
Data on shrimp is estimated based on "shrimp survey" described in the following chapter of the report.
Income on livestock is estimated in the following section based on the average number of livestock per household.

Estimation of Averaged Household Income from Livestock (supplemental discussion)

Income from livestock indicated in the above table was estimated based on the idea explained as follows. First, average number/head of livestock is estimated by type of livestock and type of cropping pattern coded to the responses. To be fair, this average is estimated based on the total number of particular livestock divided by the number of samples listed at the far right column of the table; zero is

also counted as a part of calculation (Table 3.8.3).

Table 3.8.3 Average Number of Livestock per Household (unit: ha/household)

Cropping Pattern	Cow	Pig	Goat	Chicken	Duck	No. of Samples
Fruit-Livestock		2.8	0.1	28.5	1.9	13
Paddy-Fruit-Livestock	1.0	6.3				3
Paddy-Livestock	3.0	1.4		2.3		22
Shrimp-Fruit-Livestock				100.0		1
Shrimp-Livestock		1.3		12.5	12.5	4
Average	**1.6**	**2.1**	**0.0**	**13.3**	**1.7**	**43**

Note: Average is calculated based on the total number of samples for each cropping pattern, including the ones that have no value for particular types of livestock.

Next, typical household for livestock rearing was projected in Table 3.8.4. Net income per household was actually estimated in the previous section. Yet, that estimation was based on a slightly different dataset, and therefore, the data was modified to be consistent with the data series shown above. Specifically, net income of each type of livestock is converted to "per head" value and that was re-converted to the "per household" according to the number of each type of livestock shown above.

As shown in Table 3.8.4 (simple) and Table 3.8.5 (detail), a simulated household model maintain an average of 1.6 heads of cow, 2.1 heads of pig, 13.3 chickens, and 1.7 ducks. Upon this composition, farmers who maintain livestock can expect 19,638,000VND/household. Note that this value is based on those who rear livestock as a supplemental commodity to main commodities (paddy, shrimp, and fruits).

Table 3.8.4 Net Income from Standardized Livestock Rearing per Household (Simple)

(Unit: 000VND or head)

Species	Net Income	No. of Livestock Raised	Income per Head	Livestock per Model Household	Income per Household
	(000VND)	(No.)	(000VND)	(No.)	(000VND)
Cow	11,835	3.3	3,616	1.6	5,803
Pig	35,189	6.5	5,432	2.1	11,369
Goat	9,098	48.7	187	0.0	4
Chiken	1,850	21.3	87	13.3	1,154
Duck	750	1.0	750	1.7	1,308
Total					**19,638**

Note: net income data is derived from Table 3.7.1.

Table 3.8.5 Net Income from Averaged Livestock Rearing per Household (Detail)

Species		Cow	Pig	Goat	Chicken	Duck	Total
Net Income (000VND)		11,835	35,189	9,098	1,850	750	
No. of Head Raised (No.)		3.3	6.5	48.7	21.3	1.0	
Income per Head (000VND)		3,616	5,432	187	87	750	
No. of Livestock per Model Household (No.)	Fruit-Livestock		2.8	0.1	28.5	1.9	
	Paddy-Fruit-Livestock	1.0	6.3				
	Paddy-Livestock	3.0	1.4		2.3		
	Shrimp-Fruit-Livestock				100.0		
	Shrimp-Livestock		1.3		12.5	12.5	
	Average	**1.6**	**2.1**	**0.0**	**13.3**	**1.7**	
Income per Household (000VND)	Fruit-Livestock		15,042	14	2,478	1,442	**18,977**
	Paddy-Fruit-Livestock	3,616	34,402				**38,018**
	Paddy-Livestock	10,849	7,407		198		**18,454**
	Shrimp-Fruit-Livestock				8,706		**8,706**
	Shrimp-Livestock		6,790		1,088	9,375	**17,253**
	Average	**5,803**	**11,369**	**4**	**1,154**	**1,308**	**19,638**

Note: net income data is derived from Table 3.7.1.

3) Estimation of Net Income from Major Cropping Pattern per Household

After all, income of model household is estimated by major cropping patterns. Table 3.8.6, estimates the income per cropping pattern based on the ratio of major commodities (Table 3.8.1) and expected income per commodity (Table 3.8.2). As a result, typical net income for mono-cropping of paddy is 36,217,000 VND/ha or US$ 1,748/ha and that of shrimp is 31,289,000 VND/ha or US$ 1,510/ha. As for a combined system, paddy-shrimp, for example, shows a total of 57,865 VND/ha or US$ 2,793/ha, which is much higher than mono-cropping of each commodity.

Among all, the most profitable one is found "fruits-livestock" with an expected income of 76,318,000 VND/ha or US$ 3,683/ha. Yet, the original estimation in the income of fruits may entail escalation of unit price of coconuts at the time the survey was carried out. As exampled by "paddy-fruits-livestock," the second, third and fourth highest cropping patterns are all associated with fruit production in its composition. To add with, the least income is estimated with a mono-cropping of shrimp, 31,289,000 VND/ha (US$ 1,510/ha), which is followed by mono-cropping of paddy.

In addition, income per household is also estimated, for reference, based on the average land area derived from actual arrangement on the field. As shown in the same table, the highest income is found for "paddy-shrimp" with 99,769,000 VND/household (US$ 4,815/household), which is followed by "shrimp" (65,811,000 VND: US$3,176), mostly because relatively bigger area planted per household. The least one is "fruits" that has 31,174,000 VND/household (US$ 1,504/household) due to limited size of area planted.

In conclusion, as overall average, typical household can earn approximately 50,462,000 VND/ha (US$ 2,435/ha) and 61,260,000 VND/household that maintains an average of 1.21 ha/household. Note that, however, this estimation is based on expected cost and income derived from mono-cropping of each commodity. Therefore, risk of potential reduction in the yield of shrimp and/or paddy under combined system of those commodities is not concerned.

Table 3.8.6 Income from Major Cropping Pattern per Household (Unit: 000VND)

Cropping Pattern	Net Income Per Hectar						Average Area/HH (ha)	Per Household	
	Paddy	Shrimp	Fruit	Live-stock	Total	(US$)		VND	(US$)
Paddy	36,217	0	0	0	36,217	1,748	1.46	52,725	2,544
Paddy-Shrimp (adj)	36,217	21,648	0	0	57,865	2,793	*1.72*	99,769	4,815
Shrimp	0	31,289	0	0	31,289	1,510	2.10	65,811	3,176
Paddy-Livestock	36,217	0	0	19,638	55,855	2,696	0.46	25,714	1,241
Fruits	0	0	56,680	0	56,680	2,735	0.55	31,174	1,504
Fruits-Livestock	0	0	56,680	19,638	76,318	3,683	0.58	44,470	2,146
Paddy-Fruits	31,271	0	7,740	0	39,011	1,883	1.62	63,254	3,053
Total/Ave					**50,462**	**2,435**	**1.21**	**61,260**	**2,956**
Average is a simple average of all the cropping patterns listed in the table.								**VND/US$**	20,721

3.9 Learning Opportunities for Agricultural Technologies

Table 3.9.1 shows types of learning opportunities the respondents had before to acquire agricultural and/or aquacultural technologies. Of a total of 554 valid responses to a multiple-answering question, the most popular opportunities were technical advice from extension officers at nearby office (156 responses, 28% of the total responses) and TV program on agricultural practice (151 responses, 27%), which were followed by radio program (123 responses, 22%); those three opportunities share 77% of the total responses, having more than 100 responses each.

There were some respondents who learned agricultural and aquacultural technologies from newspaper (58 responses, 10%) and other farmers in the same village (47 responses, 8%); they have responses of 50 or around. On contrast, there were only a few respondents who learn from family members (7 responses) or other farmers outside the village (5 responses). As such, typical households in this area

learn agricultural technologies extension officers or major mass media.

Table 3.9.1 Types of Learning Opportunities to Gain Agricultural Technologies

District	Extension Officer	TV	Radio	News-paper	Farmer in the Village	Family	Farmers outside the Village	Others	School	Total
Ba Tri	24	26	19	5	7	3	1		0	85
Cai Nuoc	32	22	23	13	7	1	0	1	0	99
Cang Long	24	25	24	17	7	1	0		0	98
Giong Trom	33	42	23	6	14	0	1		0	119
Phuoc Long	32	25	24	10	10	2	2	4	0	109
Vinh Chau	11	11	10	7	2	0	1		2	44
Total	**156**	**151**	**123**	**58**	**47**	**7**	**5**	**5**	**2**	**554**
	28%	**27%**	**22%**	**10%**	**8%**	**1%**	**1%**	**1%**	**0%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012). Note: Based on a multiple answering question

In the meantime, major topics that the respondents learned are summarized in Table 3.9.2 based on a multiple-answering and open-ended question. The most popular topics they learned was "shrimp culture/ aquaculture" with 48 respondents out of a total of 145 valid responses (33%), which was followed by "cultivation" technologies of paddy (34 responses, 23%); those two topics share 55% of the total responses. Other topics had received only a limited responses including "chemicals/pesticide" (8 responses), "diseases" (7 responses) and plant breeding (4 responses). There were also two cases of being provided agricultural materials.

Table 3.9.2 Types of Topics Learned

District	Shrimp Culture/Aquaculture	Cultivation (Paddy)	Chemical/ Pesticide	Insect	Diesase	Plant Breeding	Livestock	Provision of Material	Others	Total
Ba Tri									1	1
Cai Nuoc	19	1	2			2		1	11	36
Cang Long		12	6			2			6	26
Giong Trom		8		8	7		2		5	30
Phuoc Long	20	13						1	7	41
Vinh Chau	9								2	11
Grand Total	**48**	**34**	**8**	**8**	**7**	**4**	**2**	**2**	**32**	**145**
	33%	**23%**	**6%**	**6%**	**5%**	**3%**	**1%**	**1%**	**22%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Based on a multiple answering and open-ended question

3.10 Occurrence of Periodical Flood and Saline Intrusion

Table 3.10.1 summarizes the frequency of responses to experiencing periodical flood and/or saline intrusion. As a whole, 64 respondents (30%) were found experiencing periodical flood and 102 respondents (48%) periodical saline intrusion. By district, majority of the respondents in Giong Trom (Ben Tre) and Phuoc Long (Bac Lieu) are experiencing periodical flood: 27 and 21 responses respectively. Similarly, majority of respondents in Ba Tri (Ben Tre) and Giong Trom (Ben Tre) are having periodical saline intrusion.

Table 3.10.1 Experience of Periodical Flood and Saline Intrusion

District	Flood		Saline Intrusion	
	Yes	No	Yes	No
Ba Tri	5	33	**29**	9
Cai Nuoc	4	35	7	32
Cang Long	3	27	15	15
Giong Trom	**27**	15	**37**	5
Phuoc Long	**21**	20	11	30
Vinh Chau	4	17	3	18
Total	**64**	**147**	**102**	**109**
	30%	**70%**	**48%**	**52%**

Source: Questionnaire Household Survey, JICA Project Team (2012)

Short Summary

- Majority of respondents in Giong Trom and Phuoc Long are having periodical floods.
- Majority of respondents in Ba Tri and Giong Trom are having periodical saline intrusions.
- As a whole, 30% of the respondents are having periodical floods and 48% saline intrusion.

3.11 People's Reality on Climate Change

1) Type of Climate Changes Observed

In the questionnaire survey, it was asked what kind and what degree of climate change respondents observed in the past few decades; the answers were summarized in Table 3.11.1. Of a total of 367 respondents, the observation the most frequently pointed out was "(prolonged) high temperature" receiving 84 responses or 23% of the total number of responses. The second most prevalent observation was "unusual rain" including two antagonistic patterns of too prolonged or increased rainfall and decreased rainfall (72 responses, 20%).

Then, the third popular observation was saline intrusion having 58 responses (16%). To be sure, this issue did not prevail in all the districts but concentrated only in Ba Tri and Giong Trom both in Ben Tre, suggesting the saline intrusion as a location specific issue. The forth one was general "weather change" or "irregular climate," which provably represent the unsynchronized weather with ordinal seasons (54 responses, 15%) constituting temperature and precipitation.

Other observation suggested include: flood/ high water level (26 responses, 7%), increase in disease/ insect (20 responses, 5%), and drought (19, 5%). One of the features that illustrate the complication of climate change in the Mekong Delta is, as discussed, the mixture of various factors that may be even antagonistic to each other especially when concerning water distribution.

Table 3.11.1 Climate Change Respondents Observed

District	High Temperature (prolonged)	Unusual Rain (prolonged/increase/ decrease)	Saline Intrusion	Weather Change/irregular climate	Flood/High Water Level	Increase in Disease/insect	Drought	Water Pollution	Change of Season (dry-wet)	Not Particular	Others	Total
Ba Tri	16	11	22	1		6	6					62
Cai Nuoc	10	9	6	18	10		2	10			1	66
Cang Long	10	8	1	13		5	4	1		6		48
Giong Trom	23	17	26	9	10							85
Phuoc Long	19	22	2	9	5	8	6	4	5	1	4	85
Vinh Chau	6	5	1	4	1	1	1		2			21
Grand Total	**84**	**72**	**58**	**54**	**26**	**20**	**19**	**15**	**7**	**7**	**5**	**367**
	23%	**20%**	**16%**	**15%**	**7%**	**5%**	**5%**	**4%**	**2%**	**2%**	**1%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Based on a multiple answering and open-ended question

In this summary, there were a few items that do not necessarily be a direct indicator of climate change, such as water pollution, saline intrusion and increase in disease and insects. For farmers' reality, those subsequent results also well explain the influence of climate change. It may be true but it could also be a misinterpretation of natural phenomenon.

For example, hydrological dynamics of the Mekong River is at the verge of significant change due to the plans of recent large-scale water resource development by the neighbor counties upstream the river. As a result, location and extent of stagnant water has been unintentionally changed in which farmers

see problems of water pollution or saline intrusion. In this scenario, if the local precipitation is significantly decreased by the climate change, farmers may consider that the water pollution is associated with the decrease in rainfall instead of massive change in hydrological characteristics of the Mekong River.

2) Damages or Losses in Agriculture and Aquaculture Caused by Climate Change

The respondents of the questionnaire survey claimed some tangible damages or losses caused mainly by climate change on their own reality. As shown in Table 3.11.2, there were a total of 462 valid responses. The most frequent issue was "damage to coconuts" including the reduced size of coconut fruits and also fallen fruits by strong wind (211 responses, 46% of the total number of responses).

The second most common issue was "decreased production" associated with any kind of commodities (not specified). This issue (57 responses, 12%) was observed only in Ba Tri and Giong Trom of Ben Tre province, it is likely paddy production was damaged by saline water.

Negative impact in aquaculture was also addressed; damage to shrimp (51) accounts for 11% of the total number of responses. Then, increased disease and insects were also given 50 responses; increased temperature tends to harness viruses, pathogenic bacteria, and insects—farmers claim. Farmers in Giong Trom claimed particularly about loss of seedlings. It sounds realistic considering the fact that plants easily receive damages especially at the early stage.

Table 3.11.2 Major Damages or Losses Caused by Climate Change

District	Damage to Coconut	Decreased Production	Damage to Shrimp	Increased Disease/insect	Yield Loss (common)	Damage to Paddy	Loss of Seedling	Others	Total
Ba Tri	38	31		11		7		1	88
Cai Nuoc	39		22		10			11	82
Cang Long	30			6	18	3		6	63
Giong Trom	42	26		19			7	5	99
Phuoc Long	41		24	14	7	8		7	101
Vinh Chau	21		5		1			2	29
Grand Total	**211**	**57**	**51**	**50**	**36**	**18**	**7**	**32**	**462**
	46%	**12%**	**11%**	**11%**	**8%**	**4%**	**2%**	**7%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Based on a multiple answering and open-ended question

3) Countermeasures Taken

To cope with climate change problems, the respondents have taken a series of countermeasures. As shown in Table 3.111.3, the most common countermeasure was "application of chemicals/ medicines" that is to cope with diseases enhanced by increased temperature or prolonged hot weather (27 responses, 28% of the total responses). The second frequent answer was "construction or improvement of embankment," implying that farmers or fisher folks do some earthworks by themselves to prevent their paddy field, shrimp pond or other agricultural plot from saline water (26 responses, 27%).

Application of irrigation or water control is also seen as a countermeasure to deal with saline intrusion and unstable rainfall, having 20 responses (21%). Those three countermeasures shared 76% of the total number of responses. Other countermeasures claimed by the respondents were: "canal dredging/ drainage (7 responses, 7%)," "change of cropping pattern (3 responses, 3%), "change in the use of fertilizer (3 responses, 3%)," and others.

Table 3.111.3 Countermeasures Taken by the Households

District	Application of Chemicals/ Medicines	Embankment Construction/ Improvement	Irrigation/ Water Control	Canal Dredging/ Drainage	Change of Cropping Pattern	Change in the use of fertilizer	Not Particular	Others5	Total
Ba Tri	7		7				1		15
Cai Nuoc	7	1	6	1	1	1		2	19
Cang Long	3		2	4			1	6	16
Giong Trom	6	22	2		1	2			33
Phuoc Long	4	3	3	1	1				12
Vinh Chau				1					1
Grand Total	**27**	**26**	**20**	**7**	**3**	**3**	**2**	**8**	**96**
	28%	**27%**	**21%**	**7%**	**3%**	**3%**	**2%**	**8%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Based on a multiple answering and open-ended question

It is noteworthy that some farmers have changed or shifted their cropping pattern and changed the method of fertilizer application; they have already "adapted" their farming style along with the climate change.

4) People's Observation on Saline Intrusion

Table 3.11.4 shows the respondents' observation on any change in the condition of saline intrusion at their field or canals nearby. Of a total of 183 valid responses, 132 respondents, or 72% of the total number of respondents, answered "yes" that they have observed some changes on saline intrusion. Among a total of 39 valid responses that specified what actually happened in their field or around, "prolonged" and "increased" reached 11 each (28% of the total number of responses).

To add with, saline intrusion has become "erratic (6 responses, 15%) and "early starting (2 responses, 5%). In this survey, a total of 30 responses (77%) were given generally to negative connotations: "increased," "prolonged," "erratic," and "early starting." By location, there were four districts where change in the situation (yes) is dominant. Specifically in Giong Trom, 41 responses were given to "yes," while only one response was given "no." On the other hand, the number of responses given to "no" was dominant in Cang Long (16/29) and Vinh Chau (11/20), although the numbers given to each answer were not so different.

In the meantime, there were a total of nine responses given to "decreased," which was due to the installation of sluice gates and/or increased rain. While saline intrusion per se is increasing to a wider extent, totally different situation is created by artificial manipulations location by location. It suggests that location specific conditions of saline intrusions are intermixed by area.

Table 3.11.4 Saline Intrusion at Farmers' Field or Canals Nearby

District	Yes	No	Total	Prolonged	Increased	Decreased	Erratic	Early starting	Total
Ba Tri	26	5	31	2					2
Cai Nuoc	24	7	31		3		6	1	10
Cang Long	13	16	29	1		7		1	9
Giong Trom	41	1	42	8					8
Phuoc Long	19	11	30		6	2			8
Vinh Chau	9	11	20		2				2
Total	**132**	**51**	**183**	**11**	**11**	**9**	**6**	**2**	**39**
	72%	**28%**	**100%**	**28%**	**28%**	**23%**	**15%**	**5%**	**100%**

Source: Questionnaire Household Survey, JICA Project Team (2012)
Note: Based on a multiple answering and open-ended question