

## **Policy Briefs for Grants to Development Research Supported Through Denmark's International Development Cooperation**

**Introduction:** the project including five objectives and approached some main results.

**Objective # 1:** To develop multiple tolerant rice varieties by incorporating two QTLs for salinity tolerance and submergence tolerance traits in one rice variety:

Crosses were made between AS996-Saltol- and AS996 Sub1, BT7 Saltol and BT7 Sub1. Variety AS996 used for the South and variety BT7 used for the North. Q5DB-Saltol crossed with Q5DB-Sub1 were developed and tested. Other promising lines also developed.

- SSR molecular markers were used for advanced selection.
- Green house testing for salinity and submergence stresses using IRRI standard methods were performed, showing that these lines were tolerant to both salinity and submergence with from medium to high marks.
- Field screening and testing for salinity and submergence stresses were performed, showing that these lines were tolerant to both salinity and submergence.

BT7 and AS996/Saltol-Sub1 promising lines were possessed both salinity and submergence stress tolerance. They had the same agronomics characters as the original varieties.

**Objective # 2:** To improve further tolerance to salinity by incorporating additional QTL into salinity tolerance varieties developed, derived in the first phase;

- Crosses were made between AS996-Saltol-Sub1 with Capsule (IRRI variety carrying an additional QTL for salinity tolerance), F3 plants were grown in the field and seeds F4 were harvested in 2016.
- SSR molecular markers were used for advanced selection.
- Green house testing for salinity stresses using IRRI standard methods were performed, showing that these lines were tolerant to salinity stress at level 0.6% in 20 days.
- Field testing for salinity stresses showed that the lines carrying both Saltol and Capsule QTLs were well adapted to salinity stress
- The F4 lines with high salinity tolerance will be used as the good germ-plasm for home country research in near future.

**Objective # 3:** To deploy and disseminate the newly developed rice varieties tolerant of submergence and salinity stresses. And to assess water management and cropping system options for the two target provinces to cope with different scenarios of SLR.

1) Large-scale field trials of 2015 for Sub1 and Saltol (separately) introgression elite rice varieties in study sites (in Bac Lieu for MRD, and in Nam Dinh and other provinces of RRD)

2) VCU (first or second or third crop season) and DUS (first or second crop season) testing of some salinity (Saltol) and submergence (Sub1) tolerant varieties developed by the Project. These tests were carried out by the National Plant Testing Center.

A total of 11 new varieties were selected and sent to the National Plant Testing Centre for VCU and/or DUS testing in 2015:

- 5 varieties for submergence tolerance

- 6 varieties for salinity tolerance

- The results of VCU shown DMV58, OM22 were possessed high quality and salinity tolerance and disease resistance. The high yields of the both new varieties were shown.

- The results of VCU shown SHPT2, SHPT3 were possessed Submergence tolerance and disease resistance, high yield.

3) From the adaptation objective, the project has successfully assessed different water management and cropping system options, as well as identified areas that need flood tolerant and salinity tolerant varieties for Bac Lieu, to cope with different scenarios of SLR. Since the impacts of SLR in Nam Dinh on are small, the use of submerge and salinity tolerant varieties are adequate to cope with SLR in ND.

**Objective # 4:** To assess the impact of SLR on salinity and submergence stress and the consequential vulnerability of rice production of target regions via hydrological characterization

At both sites, the Project calibrated and validated suitable hydraulic models (VRSAP model for BL and MIKE 11 for ND). The models successfully quantified the hydrological properties (water levels, flows and salinity) of the canal systems surrounding and inside the study sites at the current sea level and at different SLR scenarios (SLR = 12, 15, 30, 50, 75 cm). For all the sea levels, the computation was carried out for to 3 different hydrological conditions (normal, low dry season year and high water year). The impact on flood-related stresses was carried out for high water year, and that on salinity stress for low water year. The project organized some meetings with the Irrigation Centre in Giao Thuy, Nam Dinh. Here the farmers and local governments had chance to understand more about global climate change and its impact in Vietnam coastal regions, how to adapt with climate change.

The Project presented the methodology and initial results to the Board of Directors of Xuan Thuy Water Management system in Nam Dinh. Results of the work in the MRD were presented to The Department of Agriculture (DARD) of Bac Lieu. Through these interactions, water resource managers and policies makers became more aware of the possible impact of SLR on their localities.

**Objective # 5:** To enhance capacity of Vietnamese institutions and to promote well-informed policy making through training, project workshops, participation in conferences, policy dialogues, and publications

- Via joint efforts in-country degree training (Ph.D. and M.Sc.) and Non-degree training (shuttle research) at IRRI, methodology technical capacity of AGI staff has been enhanced. AGI was the first institute of Viet Nam applied MABC method for rice breeding. In the project, the MABC method is used for salt tolerance and submergence tolerance rice breeding. The success of this were changed the mind of both policymakers and scientists in molecular breeding. The change will be presented in a new circular letter to accept a new rice variety which has the same morphology characters of the original one , but has one more resistance character. The new resistance characters must be shown using molecular linked markers.

**Background:** issue and context of the project and its approach and methodology, highlighting the value added.

- The main issue of the project were 3 new national rice varieties, among them, 1 is salinity tolerance variety OM22. 2 submergence tolerance are SHPT2 and SHPT3. One more salinity tolerance variety DMV58 is on the way to be accepted.

- On methodology, we carried out successfully MABC when pyramiding 1- 2 new genes into a popular rice variety, but remained almost the original agronomics characters, only added one more resistance character. The use of method MABC in screening and breeding can shorten the breeding time within 2 to 3 years, compared with the normal 6-10 years in case using conventional approaches. This is the success of the scientists in Agricultural Genetics Institute. Some of research proposals using the MABC approaches have been applied recently in the National program of rice breeding

AGI has received the support by IRRI, IMHEN and SIWRP, who are also responsible for some specific activities. Almost all activities of the project have been performed well and outdone as scheduled. .

**Results:** What did we learn? Which capacity was built? Summary of the facts, easy to understand. Ensure that your research findings are explained in the context of the available evidence on the subject.

We have succeeded in rice breeding through the project “Improving rice tolerance of submergence and salinity to cope with climate change in coastal areas of Vietnamese Deltas”:

\* The best Saltol-incorporated varieties are highly tolerant to salinity at 0.3-0.4% salt level, and are medium tolerant at 0.6% salt level, (while the sensitive check dies).

\* The best Sub1-incorporated varieties can 89% survive in case of 21 days submergence (while the sensitive check dies).

The project delivers 3 national varieties:

\* The variety OM22 (tolerant to salinity) has been approved by MARD as a new Variety of Trial Production for the South of Vietnam.

\* The varieties SHPT2 and SHPT3 (tolerant to submergence) have been approved by MARD as new Varieties of Basic Range Trial Production for the North

Additional, DMV58 from the project is salinity tolerance variety that was created from BT7. The BT7 is the popular high quality variety that occupies about 20-30% area of coast field in the North. Bac Giang seed Production Company is implementing field trial in 6 provinces of the North in 2016. DMV58 shown not only Salinity tolerance, but also more cold and disease tolerance than original variety BT7 and 5-10% higher yielding than BT7. We are trying one's best to speed up process to be admitted DMV58 as the new national rice variety and disseminate the very good variety DMV58 for the North.

Human power and research facility of AGI were enhanced through the project training and supplement equipment.

Two parts of the project: breeding and geospatial analysis have closed link to common goal in the two project sites (Nam Dinh and Bac Lieu provinces). Interactions between the Project and the local governments of the two study sites have been excellent and enhanced the relevance of the project to local people.

- Complete assessment of the impact of SLR scenarios on salinity and flood regimes for BL province. A series of GIS-based maps showing the spatial and temporal changes in salinity and flood regimes induced by SLR for BL. For each SLR scenario, these maps showed the changes (i.e. with SLR vs without SLR)

- GIS-based maps, for ND, of areas affected by different flood depths (<0.05, 0.05 – 0.25, 0.26 – 0.50, 0.51 – 1.00 and >1.00 m) that sustained for 1, 3, 5, 7 days....) in September (month with highest rainfall); and areas affected by different salinity (S < 1.0, 1 – 2, 2-4, 4-6, >6 g/L) in January (month with highest salinity) or the current sea level and different SLR scenarios.

- Salinity profiles along Ninh Co, and Red rivers during Jan – April at the present sea level and with different SLR scenarios.

There have been close link between Vietnamese and IRRI researchers. IRRI played a major advisory role and offer technical assistance in all aspects of the project.

## **Conclusions:**

The new rice varieties delivered from the project are very good rice varieties to cope with climate change in the coastal areas in Viet Nam. Additionally, the genetics resources (Saltol and Sub1 genes in breeding lines) from the project are good material for next research in Viet Nam to cope with climate change and SLR. Up to now, 3 seed production companies of Ninh Binh, Hai Duong, Bac Giang were responsible together with AGI scientists to disseminate the new rice varieties to avoid crop damage from climate change and SLR impacts.

The use of models MIKE11 and VRSAP to predict water level and salinity on farmers' fields, will require innovative integration of knowledge on water and agriculture management at different scales.

## **Implications:**

The results of the project contributed to Viet Nam rice breeding to contact with new methodology. The new rice salinity and Submergence tolerance varieties were the proofs for that. The Cultivate headquarter of Agriculture and Rural Development Ministry will change papers to accept a new rice variety which has the same 62 agronomic characters of the original variety, but has one more resistance character and must be demonstrated by molecular markers.

The policy maker in project sites have been enhanced knowledge about impacts of climate change and encouraged farmers to grow the new rice salinity and Submergence tolerance varieties.

**Recommendations:** Call to action, which precise steps should be taken? (both flowing from conclusions, supported by evidence and be feasible and "actionable").

The project have been completed and released 3 new rice salinity and Submergence tolerance varieties. The grant from the project gave us a good chance to make good rice varieties to cope with climate change in Viet Nam. The project also completed assessment of the impact of SLR scenarios on salinity and flood regimes for Bac Lieu and Nam Dinh provinces. During the project time, we had effective communication to farmers and local policy makers about impact of climate change and the necessary actions. To delay global climate change, we gave them recommendations for sustainable agriculture development, growing disease resistant crops to reduce using chemical pesticide... The Project staff showed them why we need to grow rice salinity and Submergence tolerant varieties to cope with climate change and to ensure food security.

The project scientists group is trying one's best to disseminate the new rice varieties to reduce the crop damage from the impact of climate change.

In the other hand, we have proposed to Ministry of Agricultural and Rural development for the national rice breeding project to cope with climate change.

Now the project scientists group is leader group in working on rice salinity tolerance breeding national project to cope with climate change.